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Essays on the US community banking system: Financial Risk, Efficiency and Competition

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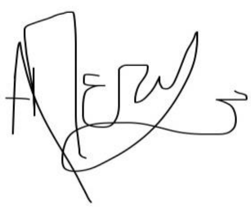

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Abstract

A peculiarity of the US banking system is that it spans from a few large and systemically important banks to many, small community banks. Changes in the US banking sector during 1990s have diminished the number of community banks. During the banking crises of late 1980s to early 1990s and the Global Financial Crisis, over 2,500 community banks ceased operations. However, community banks still account for 92 percent of the total number of banks, suggesting that they are a fundamental part of the US banking system. A striking feature that differentiates community banks is that they are considered to be “relationship bankers”. They are small in terms of their asset size and operate within limited geographic scope. They engage mostly in traditional loan making and deposit taking activities and their ownership structure is concentrated. In this thesis, we investigate how the uniqueness of the community banking business model translates in differences in the risk profile, efficiency and market power of community versus non-community banks.

First, we compare insolvency, credit and liquidity risk of community banks to their non-community counterparts using an array of bank-specific, macroeconomic and market structure variables. We uncover strong evidence that community banks have lower insolvency and credit risk but higher liquidity risk. Furthermore, the community bank risk profile shows important similarities and differences in the sensitivities to an extensive array of financial indicators. Second, we compare the two bank types on the basis of cost efficiency and we further decompose efficiency into a persistent and a residual component; the former capturing market structure and regulatory changes, the latter reflecting managerial performance. We find evidence of higher efficiency for community banks and the decomposition reveals that community banks benefit from superior managerial capabilities and from developments at the regulatory front. The third study analyses the relationships between capitalisation, stability and efficiency in the US banking and introduces for the first time the effect of competition on that nexus. By including business model dynamics in the above nexus, we investigate how the relationship approach adopted by community banks fares against its competitors. Empirical evidence from this study confirm our results from the two previous studies on stability and efficiency and bring to light novel findings for higher market power for community banks. Our findings have important implications for regulators in tailoring the supervisory practices to the unique characteristics and different nature of challenges that each bank group faces.

List of abbreviations

3SLS	Three stage least squares
C&D	Construction and development
C&I	Commercial and industrial
CAMEL	Capital adequacy, Asset quality, Management, Earnings, Liquidity, and Sensitivity
CAREs	Coronavirus Aid, Relief, and Economic Security Act
CB	Community banks
CECL	Current expected credit loss
CR	Credit risk
CRE	Commercial real estate
DEA	Data envelopment analysis
EGRRCPA	Economic Growth, Regulatory Relief and Consumer Protection Act
EPU	Economic policy uncertainty
ESH	Efficient structure hypothesis
EU	European Union
FDIC	Federal deposit insurance corporation
FRA	Financial ratio analysis
GDP	Gross domestic product
GFC	Global financial crisis
HHI	Hirschman-Herfindahl Index
HMDA	Home Mortgage Disclosure Act
IR	Insolvency risk
LCR	Liquidity coverage ratio
LLP	Loan loss provisions
Log	Logarithm
LR	Liquidity risk
MC	Marginal cost
NB	Branch coverage
NPL	Non-performing loans
NSFR	Net stable funding ratio

OCE	Overall cost efficiency
PCE	Persistent cost efficiency
RCE	Residual cost efficiency
RL	Relationship lending
ROA	Return on Assets
ROE	Return on equity
SBA	Small business administration
SFA	Stochastic frontier analysis
SIFIs	Systemically important financial institutions
SMEs	Small and medium size enterprises
TA	Total assets
TBV	Traditional banking variable
TL	Total loans
TTI	Traditional income
UBS	Union Bank of Switzerland
UK	United Kingdom
US	United States
USD	Unites States dollar

Chapter 1 – Introduction

1.1 Background on community banking and motivation

The last major global financial crisis (GFC) of 2007-08 highlighted the vulnerability of the conventional banking and changed the thoughts about the principles and practices of the world mainstream banking and financial system. The exposure of the conventional banking system to various types of risks and the consequent systemic failures of the banks has led to distortions in the financial system and the spill-over of banking and financial distress to the larger economy (Hellwig 2009). In the US the removal of regulatory restrictions on interstate banking in the 1980s and 1990s led to an increase in competition and an increase in bank risk-taking. A mega trend in banking has been the decrease of traditional interest income as banks were doing more securities and less loans. However, with the GFC a lot of scepticism was put under complex derivatives and off- balance sheet structures. After the GFC and the key role that megabanks played for that, the focus has turned to alternative banking models and the tangible benefits that they can have in the economy. Still, literature is inadequate on areas of the modus operandi of alternative banking models and the disintegrated comparison of its profile vis-à-vis conventional banks using advanced methods.

A uniqueness of the US banking system is that it spans from a few, large systemically important financial institutions (SIFIs) to many, small community banks (CB). The long-standing tradition of community banks in the US dates back to the prohibition of interstate banking (McFadden 1927 Act), which increased the number of small, local (i.e., community) banks. Changes in the US financial sector however, particularly the abolishment of interstate banking prohibitions (Riegle-Neal Act and Branching Act 1994), have reduced the number of the community banks. Over 2,500 community banks have disappeared during the banking crises of the late 1980s/early 1990s and the Global Financial Crisis (GFC), while the share of banking assets held by community banks declined by 28 percentage points during the 1984 – 2012 period (FDIC 2012). Despite these structural changes, community banks accounted for 92 percent of total number of banks insured by the FDIC and 95 percent of US banking organizations in 2011, suggesting that they remain an integral part of the US banking system. According to the FDIC, community banks hold most of the deposits in US rural and micropolitan areas and almost one out of every five counties have no other physical banking offices apart from those operated by community banks. This suggests that community banks are strongly linked with geography. There is a significant difference between community and non-community banks in the degree to which they are located in rural areas. Figure 1.1 presents how the percentage of community banks changed from 1984 to 2018 in terms of their number and also in terms of the amount of assets that they hold in each state. The share of community banks is higher in rural areas that actually make up most of the country. States such as Maine (ME), North Dakota (ND), Idaho (ID) and Vermont (VT) are served exclusively by community banks in 2018. Mississippi (MS) and Montana (MT) moved from a lower percentage of community banks during 1984 (around 50% and around 80% respectively) to a much higher percentage during 2018 (around 90% both). This prevalence of community banks in nonmetro areas remains an integral part of the uniqueness and plays a catalytic role in the way they conduct business.

[Figure 1.1 around here]

One of the key characteristics of community banks is that they act as providers of microcredit, ensuring funding for SMEs and start-ups which are the backbone of the US economy. In 2016 US banks with assets less than $1 billion held more than 25% of loans extended to small businesses (Conference of State Bank Supervisors and Federal Reserve 2017). Via their lending to small firms, community bankers contribute to the development of the local economy and to the economic recovery following natural disasters (Cortés 2014). Regulatory relief in 2015 boosted small business lending by community banks and had measurable positive effects in local economies. Because hundreds of community banks failed in the aftermath of the 2008-2009 financial crisis, the sensitivity of these banks to systemic shocks poses a concern for both policymakers, community banks, and the job-creating small businesses that depend on a vigorous community banking sector. Community banks and small banks in general can be more effective than non-community banks in relieving the financial constraints that small firms face via relationship banking and reliance on soft information (Elsas 2005; Behr et al. 2013; Berger et al. 2015). Thus, the consolidation process in US banking and the disappearance of small banks can be a source of social costs (Berger et al. 2017). This indicates the desire for better public policy to ensure community banks could serve the economic needs of their communities. Understanding the way community banks do business will open the way to better policy decisions. FDIC research on community banks has shown that they are a remarkably dynamic, flexible and innovative segment of the industry. One central policy question for community banks is how they will meet the challenges of an evolving financial sector while continuing to serve as relationship lenders. In this thesis we want to uncover compelling facts about the enduring importance and sustainable business model of community banks. The next three sections of this chapter discuss the research topics studied in this thesis and provide a brief summary of the methodology, findings, and contributions for each of them.

1.2 Does relationship lending affect financial risk for US community banks?

Is the relationship lending approach of community banks any good for their financial risk profile? In order to address this research question, we assess three types of risks, namely insolvency, credit and liquidity risk for community banks and their non-community counterparts. We use data on US banks over the 1984-2013 period and the new FDIC definition that accounts for business model differences of these banks. For insolvency risk we utilize the z-score indicator following Cihák and Hesse (2007). Credit risk is proxied by the ratio of net loan losses in the current period to the allowances for these loan losses recorded in the previous period and measures the unexpected loan default ratio of the bank (Imbierowicz and Rauch 2014). For liquidity risk we utilize the respective measure of Imbierowicz and Rauch (2014), which accounts for short-term funding risks of banks, includes off-balance sheet items and accounts for classic "bank run" risks. We compare insolvency, credit and liquidity risk of community banks to their non-community counterparts using an array of bank-specific variables, such as size, capitalization, profitability, liquidity, asset quality and business orientation. We also allow for macroeconomic, financial and market structure variables to affect financial risk.

Our results show that community banks have lower insolvency risk and credit risk, but higher liquidity risk than their non-community counterparts. Furthermore, the community bank risk profile shows important similarities and differences in the sensitivities with respect to key financial indicators. In particular, capitalisation affects the insolvency risk of community banks in a similar fashion to the non-community ones. However, the community banks' insolvency risk is found more robust to asset quality changes. Our results are robust to two different specifications of the z-score, which use different time window to estimate the mean and standard deviation of the ROA as per Mare et al. (2017). The significantly lower credit risk of community banks is primarily affected by capitalisation and income diversity. Community banks' focus on traditional loan making activities and limited access to capital markets make liquidity risk more of an issue for this bank type. Moreover, we elaborate on the loan portfolio risk contributions by investigating the marginal contributions of each loan category on bank's risk profile for community and non-community banks and we investigate the impact of banking crises on the risk profile of the two bank types by using a difference-in-difference setup with a crisis dummy. In the final part of our analysis we address endogeneity concerns from simultaneity bias by using a three-stage least squares (3SLS) design and we produce results qualitatively similar to our previous analysis.

This research contributes to the literature in two important ways. We provide new empirical evidence on the comparative performance of community and non-community banks by comparing the financial risk profile of these banks in three pillars, namely insolvency, liquidity and credit risk. Also, this is the first study that compares and contrasts the sensitivity of these banks' financial risk profile to key bank-specific and macroeconomic indicators following the change of the community bank definition from the FDIC. Our findings have important implications for regulators in tailoring the supervisory practices to the unique characteristics and different nature of risks that each bank group faces.

1.3 The efficiency of US community banks

The question of how efficient small US banks are is important for economic theory and policy. If these banks are efficient then this raises the question of why large banks have been swallowing them up for the past thirty years and whether this reflects a failure of regulatory or competition policy. In this study we focus on the business model used by US community banks and we compare cost efficiency of community versus non-community banks[1]. Our approach relies on a novel method proposed by Kumbhakar et al (2014) which accounts for unobserved heterogeneity at bank-level, thereby avoiding the confounding of latent heterogeneity with efficiency. We decompose cost efficiency into a persistent and a residual component; the former capturing the market structure and regulatory changes, the latter reflecting managerial performance. In addition, we explore the bank- specific, macroeconomic and market structure factors that explain differences in the bank efficiency between the two bank types.

[1] In comparative analysis between alternative banking systems, it has been argued that focusing on profit analysis (whether in the form of profit efficiency or profit related financial ratios) may disadvantage the specialist banking group that could be following different objectives outside a strict profit maximisation dogma. In our case, community banks may be focusing on the welfare of the local community. Similar arguments have been put forward for comparative analysis between Islamic and conventional banks, where shying away from a profit efficiency study has been on the grounds that the former may have additional objectives encompassing social value and ethical behaviour (Johnes et al., 2014). By contrast, profit efficiency assumes that profit maximisation is the sole goal of the bank (Berger and Mester, 1997). This reasoning motivates our choice of cost efficiency.

Our estimates show community banks to exhibit a 4.9% higher efficiency compared to their non-community counterparts. The decomposition further reveals that community banks benefit from superior managerial capabilities and from developments at the regulatory front. Size is non-linearly related to efficiency and large community banks are the most efficient. A strong positive link between profitability and efficiency exists for community banks, with the effect being muted in non-community banks. Participation in bank holding companies is harmful for community banks' efficiency. Liquidity creation is positively (negatively) related to efficiency of (non-)community banks, and highlights the distinctiveness of the business models and the need for differentiated regulatory supervision. Community banks efficiency is positively (negatively) related to liquidity (credit) risk. We validate the robustness of our results by implementing an alternative specification of cost efficiency, two matching techniques (k-means nearest neighbour and propensity score matching) and different classification of the community banks.

To the best of our knowledge, the comparative efficiency literature for US community and non-community banks has not accounted for the distinct business model of community banks when defining them. This study departs from prior research by employing the FDIC definition of community banks rather than a single size criterion. Second, we contribute to the US banking efficiency literature by offering the first study to decompose cost efficiency into persistent and residual. Thus, we can disentangle cost efficiency differences related to policy/regulatory/structural changes from managerial capabilities. Third, this is the first study that investigates the impact of liquidity creation, credit and liquidity risk on cost efficiency.

1.4 The impact of competition on the capitalisation-stability-efficiency nexus across different bank types; the case of US community banks.

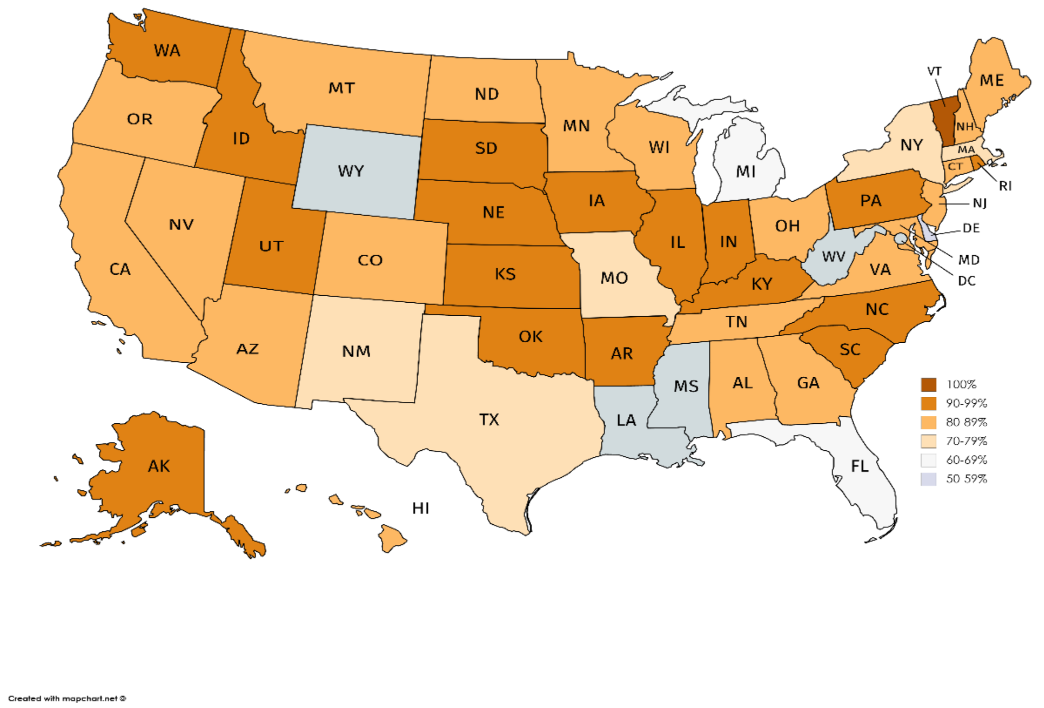
This study analyses the relationships between capitalisation, stability and efficiency in the US banking and introduces for the first time the effect of competition on that nexus. Emphasis is given in distinguishing between community and non-community banks, the former acting as a proxy for the traditional banking approach. We test the hypotheses of "bad luck", "bad management", "skimping", "moral hazard" and "regulatory hypothesis" (Berger and DeYoung 1997), the "franchise value" (Keeley 1990) and "risk-shifting" paradigm (Boyd and De Nicolo 2005), the "quiet life" hypothesis (Berger and Hannan 1998), the "efficient structure hypothesis" (Demsetz 1973) and the "information generating hypothesis" (Marquez 2002) for the US community and non-community banks. Furthermore, we examine the determinants of banking competition and whether it is primarily driven by the small-and-numerous community banks or the large-and-few non-community banks.

Empirical evidence shows higher capitalisation, greater cost efficiency, superior financial stability and higher market power for community banks. We find a positive relationship between cost efficiency and capitalisation and between stability and capitalisation which supports the “moral hazard hypothesis”. Community banks are found to be less prone to cost skimping behaviour than their non-community counterparts. Our results on competition support the “competition-fragility” view, however the traditional banking model of community banks acts as a layer of protection against competitive pressures. Community banks capitalise on information monopoly advantage and translates higher market power into higher efficiency. Market power is increased through higher efficiency in the case of non-community banks and higher liquidity creation in the case of community banks. Finally, we find that non-community banks can reap significant benefits in terms of stability, efficiency and market power when operating closer to the traditional banking model through increased relationship lending and branching.

These findings contribute to the literature in a number of ways. We introduce an important forth factor in the capital-efficiency-stability nexus that had been excluded in previous studies-competition. By including business model dynamics in the above nexus, we investigate how the relationship approach adopted by community banks fares against its competitors. Finally, we go further than the binary classification of community banks and create a continuous variable measuring the intensity of traditional banking activities which enables us to quantify the benefits and limitations of the traditional banking model.

Figure 1.1: Percentage of community banks by state in 1984 and 2018

Percentage of community banks in 1984



Percentage of community banks in 2018

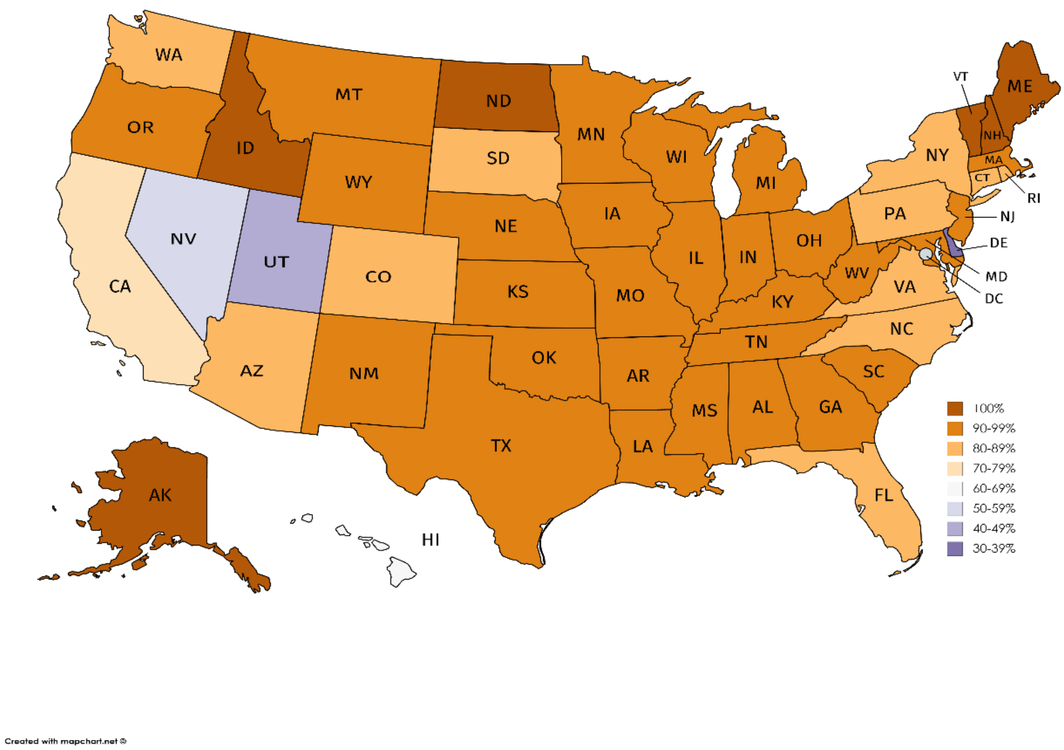
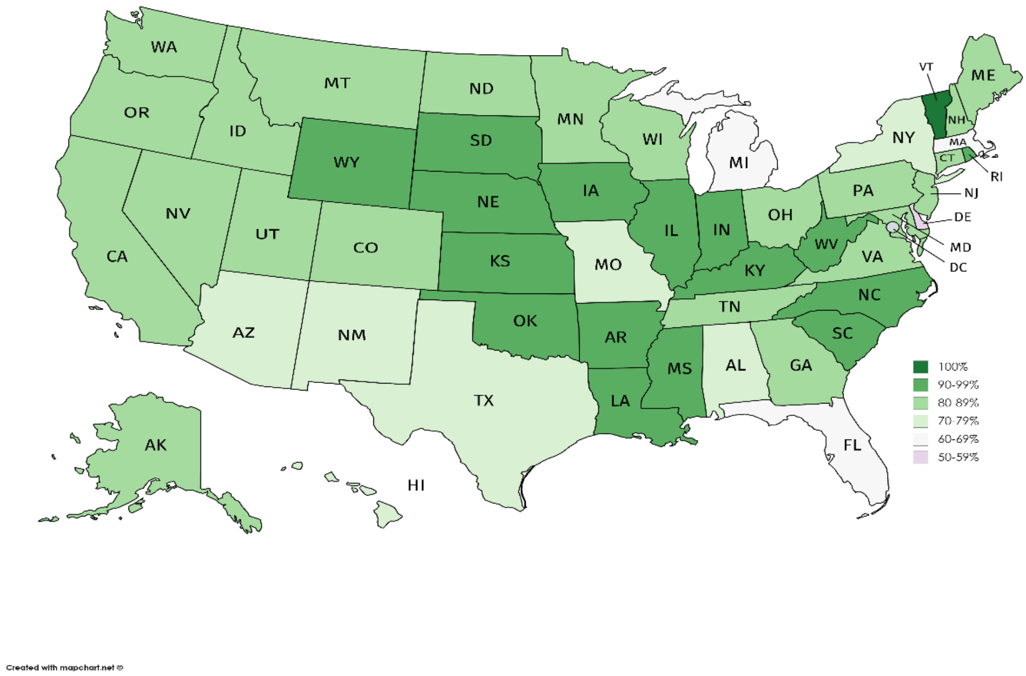
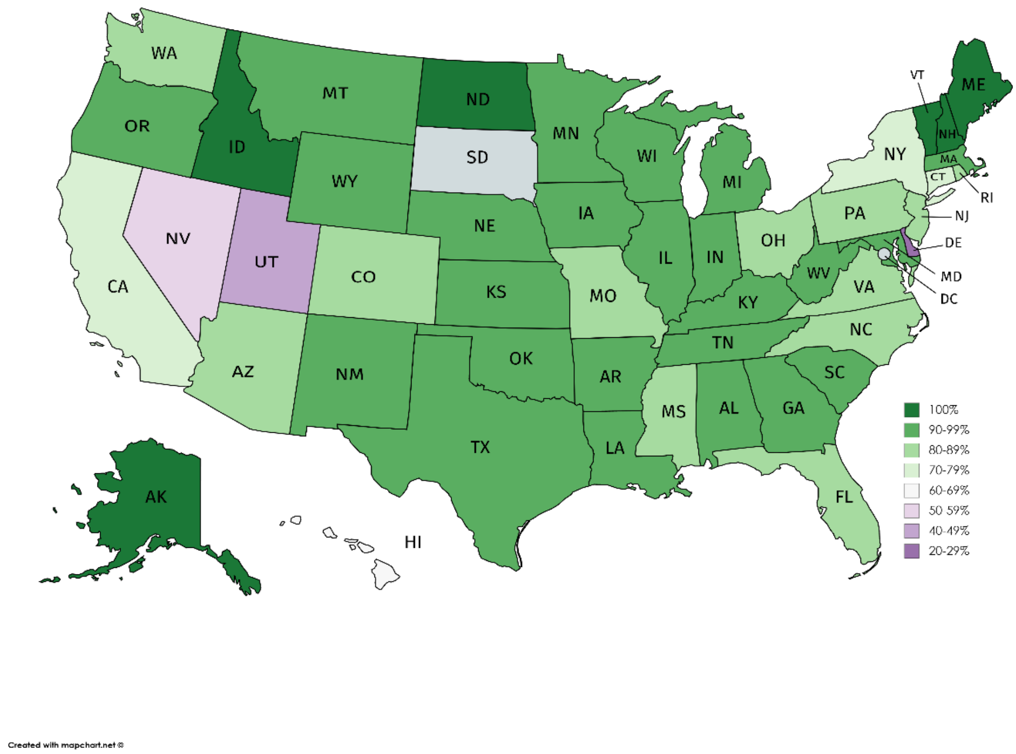


Figure 1.1 (continued)

Percentage of assets held by community banks in 1984



Percentage of assets held by community banks in 2018



NOTES: Maps show the percentage of community banks in number and in assets that operate at each state in 1984 and 2018.

Chapter 2 – Does relationship lending affect financial risk? The case of US community banks

2.1 Introduction

A peculiarity of the US banking system is that it spans from a few, large systemically important financial institutions (SIFIs) to many, small community banks (CB). The long-standing tradition of community banks in the US dates back to the prohibition of interstate banking (McFadden 1927 Act), which inflated the number of small, local (i.e., community) banks. Changes in the US financial sector, particularly the abolishment of interstate banking prohibitions (Riegle-Neal Act and Branching Act 1994), have reduced the size of the community banking sector. This has been materialised through mergers and/or acquisitions (M&A), change of status or bank failure. The technological, regulatory and legal requirements place additional challenges for the long-term survival of the smaller of community banks. Over 2,500 community banks have ceased to exist during the banking crises of the late 1980s/early 1990s and the Global Financial Crisis (GFC), while the share of banking assets held by community banks declined by 28 percentage points during the 1984 – 2012 period (FDIC 2012). Despite these structural changes, community banks accounted for 92 percent of total number of banks insured by the FDIC and 95 percent of US banking organizations in 2011, suggesting that they remain an integral part of the US banking system. According to the FDIC, community banks hold most of the deposits in US rural and micropolitan areas and almost one out of every five counties have no other physical banking offices apart from those operated by community banks. This suggests that community banks play a key role in the US economy.

Although risk in the US banking system has attracted significant academic attention, little research exists into the comparative performance of community and non-community banking. This is, in part, attributed to the relatively new definition of community banks by the FDIC. An interesting finding arising from the FDIC (2012) study suggests that community banks have a lower propensity to fail than non-community banks. This study supports the relative stability of community banks by looking at the number of failures, consolidation and mergers and acquisition for the two bank groups, the failure rates and the age distribution of charters. We are building on this study by undertaking a comparative analysis of community and non-community banks risk profile and exploring the different impact that bank- specific and macroeconomic factors have on financial risk for the two bank types.

In their intermediary role, banks are exposed to a variety of risks, most notably insolvency, credit and liquidity. The importance of insolvency risk within the banking research is reflected on the literature that seeks to identify the determinants of banking failure and/or design early warning systems that could signal a potential banking failure (Berger and Bouwman 2013; Akins et al. 2016; Aubuchon and Wheelock 2010; Betz et al. 2014; Berger et al. 2012). A more recent strand of research investigates the cross-relationship between credit and liquidity risks and/or how this affects bank stability.[2] Quite notably, Imbierowicz and Rauch (2014) find that both of these risks affect bank stability, but they also have a convoluted relationship that is particularly challenging for risk managers and regulators alike. Credit risk is pivotal to the overall stability of the bank and it has been shown that failed banks had significant exposures to non-performing loans in their balance sheet (Ng and Roychowdhury 2014; Cole and White 2012). Following from the Basel II framework there has been a renewed interest in improving the understanding of credit risk modelling, with the literature distinguishing between two types of determinants affecting credit risk; macroeconomic factors that have a systemic effect on credit risk, and bank-specific factors that affect the credit risk of individual banks (see for example Berger and DeYoung, 1997; Festic et al, 2011). Prior to the GFC, Calomiris and Mason (2000), in the analysis of the causes of bank distress during the Great Depression, find some evidence in support of the notion that illiquidity crises prompt bank failures. Following the GFC where illiquidity (rather than insolvency) has been a characteristic feature of failed banks, interest in this type of risk has been re-ignited (Acharya and Mora 2015). As a response to the financial crisis and in recognising the role of liquidity risk, the Bank for International Settlements (BIS) devoted a specific "pillar" to liquidity risk in Basel III. To measure liquidity risk, BIS has proposed two new liquidity risk measures, the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR).

From a regulatory perspective, the additional risk-types being monitored and the emergence of SIFIs as evident by the special provisions in Basel III, should at least in theory enhance the stability of the banking system.[3] However, different business practices, such as the relationship lending that community banks adopt, which could limit the asymmetric information problems that commercial banks have, may contribute to increase financial stability. Furthermore,

[2] See for example Imbierowicz and Rauch (2014); Acharya and Mora (2015); Goldstein and Pauzner (2005); Wagner (2007)
[3] See for example, http://www.bis.org/bcbs/basel3/b3summarytable.pdf

community banks engage in traditional loan- giving and deposit- taking functions; thus, steering away from the complex financial instruments structures that have been, in part, blamed for the financial exposure of commercial and investment banks during the GFC. That is not to say that community banks are not exposed to the same economic shocks as non-community banks, but the claim is that these would have a differentiated impact on the banks risk profile. This raises several interesting questions regarding the relative performance of community banks in terms of financial risk. How do these two bank types perform in terms of insolvency, credit and liquidity risk? Does their financial risk profile show different sensitivities to key bank-specific and macroeconomic indicators? Do financial crises affect their risk profile in a similar fashion? To answer these questions, we compare the financial risk profile of US community and non-community banks over the 1984 – 2013 period. We assess three types of risk; insolvency, credit and liquidity risk. For insolvency risk, we utilise the popular z-score indicator as per Cihák and Hesse (2007). Credit risk is proxied by the ratio of net loan losses in the current period to the allowances for these loan losses recorded in the previous period, and measures the unexpected loan default ratio of the bank (Imbierowicz and Rauch 2014). For liquidity risk we rely on the respective measure of Imbierowicz and Rauch (2014), which accounts for short-term funding risks of banks, includes off-balance sheet items and accounts for classic "bank run" risks. Our control variables capture bank-specific financial statement information, such as size, capitalisation, profitability, liquidity, asset quality and business orientation. In line with the literature we allow for an extensive array of macroeconomic, financial and market structure variables to affect financial risk.

Our findings from the first step of our analysis reveal that community banks exhibit lower insolvency risk than their non-community counterparts. We find that this bank type does not derive additional benefits in terms of stability from having a larger asset base, however higher capitalization, better asset quality and higher liquidity offer them a significant risk reduction effect. In terms of the macroeconomic environment, inflation is particularly relevant for the stability of community banks. This result probably reflects the strong connection of this bank type to the real part of the economy as most of their investments are tied up in loans. Our results are robust to two different specifications of the z-score, which use different time window to estimate the mean and standard deviation of the ROA as per Mare et al. (2017). The significantly lower credit risk of community banks is primarily affected by capitalisation and income diversity. The former's contribution on credit risk reduction is significantly more pronounced compared to the non-community counterparts, while the latter signifies that community banks with more focused operations on lending reap the benefits in terms of credit risk reduction compared to more diversified banks. Higher inflation weakens the community banks' customers' ability to pay their debt, thus increases credit risk. Further, our findings suggest that community banks bear more liquidity risk. Their focus on traditional loan making activities and limited access to capital markets makes liquidity risk management a challenge. In periods of higher economic growth banks tend to run down their liquidity buffers by lending more, thus increasing liquidity risk.

We elaborate more on the loan portfolio risk contributions by investigating the marginal contributions of each loan category on bank's risk profile for community and non-community banks. We do so by including in the regressions from the previous analysis the ratio of each of the loan category (i.e. Agricultural, Commercial and Industrial, Commercial Real Estate, Construction and Development, Residential Mortgages and Loans to Individuals) to total assets. Our findings reveal that loans to individuals, agricultural loans and commercial and industrial loans negatively affects the stability of community banks. In terms of credit risk, higher proportion of agricultural loans, commercial and industrial and loans to individuals increases credit risk for community banks. Further, commercial and industrial loans and loans to individuals increases liquidity risk for this bank type.

Additionally, we investigate the effect of banking crises on the risk profile of community and non-community banks. We believe this is particularly interesting since the community banking sector has proven to be more resilient during the GFC than the commercial counterparts, see for example Alton Gilbert et al. (2013). Following Berger and Bowman (2013) we use a difference-in-difference setup with a crisis dummy to capture the sensitivities of community and non-community banks' risk to bank- specific characteristics during periods of crises. Our findings suggest that liquidity risk for community banks is higher during banking crises, whereas insolvency and credit risk show no difference between normal periods and periods of crisis.

In the last part of our empirical analysis, we use a three-stage least squares (3SLS) design to eliminate any endogeneity problem from simultaneity bias. Our results suggest that the sensitivities to key explanatory variables remain qualitatively similar to our previous analysis. Further, we verify the results of Imbierowicz and Rauch (2014) by finding that liquidity and credit risk are highly interlinked. The 3SLS analysis shows some interesting results on the contemporaneous relationships between the three types of risks. In particular, higher insolvency risk increases both credit and liquidity risk, higher liquidity risk increases both insolvency and credit risk, and higher credit risk increases insolvency but decreases liquidity risk.

Our contribution to the literature is twofold. First, we compare the financial risk profile of community and non-community banks, thereby contributing to the literature on the comparative performance of these bank types. Second, we compare and contrast the sensitivity of these banks' financial risk profile to key bank-specific and macroeconomic indicators. This is the first study to embark on such task following the change of the community bank definition from the FDIC. Previous research has established a single size criterion in order to define community banks - typically $1 billion in assets. However, this definition fails to capture characteristics of the community bank business model that are not only size related. These characteristics though could have a different impact on the financial risk of this bank type. We attempt to build on the Stiroh (2004) study that finds a negative link between bank- specific factors (i.e. non- interest income and commercial and industrial lending) and community banks risk-adjusted performance. Our study is also close related to DeYoung et al. (2004) paper which finds evidence that support the economically viability of the community banking business model. Since the financial crisis and the passage of the Dodd-Frank Wall Street reform and Consumer Protection Act (Dodd-Frank Act) enhanced prudential standards have been applied and increased the differences in supervisory practices among different bank organizations. This has brought new attention to the importance of balancing regulation based on varying bank groups and the different nature of risks they face. The application of those supervisory practices need to be tailored to the unique characteristics and objectives of these bank groups. This pertains especially to community banks because regulation needs to be shaped with account to the traditional, relationship banking model and unique risk profile of this bank type.

The rest of this chapter is organized as follows: In Section 2.2 we discuss the specifics of community banks and the relevant literature. Section 2.3 describes our methodology and section 2.4 introduces the variables and the data used. In section 2.5, we provide our empirical results and test the robustness of our findings. Section 2.6 offers a brief conclusion.

2.2 Theoretical background on community banking and related literature

A striking feature that differentiates community from non-community banks is that they are considered to be "relationship bankers". They are typically small-sized and operate within a limited geographic area. Community banks engage mostly in traditional banking activities, such as loan making and deposit taking, while their ownership structure is concentrated. In this section, we briefly explain these key features of community banking and their possible impact on risk.

2.2.1 Bank size and financial profile

Community banks are generally small in size. An upper threshold of $1 billion in assets has typically been used to define a community bank (Feng and Zhang 2012; Berger and Bouwman 2013). Empirical evidence suggests that large banks may be less likely to fail as they are better in diversifying credit risk, reap economies of scale and have better access to capital markets (Shaffer 1989). The ability of the bank to access external funding depends on size. Large banks have broad access to financial markets, while community banks cannot access such markets easily. As such liquidity management in community banks may be more challenging.

Small bank size is often associated with inefficiency as they are not able to use economies of scale/scope to their advantage. Banks with assets below $25 million are, on average, less efficient and a critical asset size of at least $50 million is required for the bank to be efficient (Shaffer 1989). Inefficient banks exhibit lower asset quality and a higher propensity to fail (Kwan and Eisenbeis 1997; Wheelock and Wilson 1995). This might be because inefficient banks incur higher costs and/or have inferior management, which may prove critical at times of distress. The largest percentage of failing banks had assets below $25 million during the 1984-1988 period (Shaffer 1989). Yet, small banks can build protection for themselves by specializing in niche markets. For example, Cihák and Hesse (2010) find that small Islamic banks face lower insolvency risk than similar sized commercial banks.

Low profitability makes it difficult for the bank to increase its capital base and enhance its viability (Arena 2008). Large asset size is often associated with high profitability through better investment/diversification opportunities these banks enjoy, and consequently lower failure risk (Calomiris and Mason 2000). Still, it is possible for small, often highly specialised banks to outperform large banks in terms of profitability. For example, Bassett and Brady (2001) finds that banks with less than $1 billion assets managed to outperform larger banks in terms of profitability. Large banks under the "too-big-to-fail" doctrine can exploit their dominance in the market by taking disproportionate risks (and reaping the extra returns) on the assumption that under financial distress they will be bailed out (Boyd and Runkle 1993).

2.2.2 Relationship banking

A stark difference in the community banking model is that they are considered to be "relationship bankers" rather than "transactional bankers". Under "relationship lending" approach, credit decisions are based primarily on "soft information", which would include non-standard data and qualitative information that is related to human interaction. "Transaction banking", on the other hand, suggests that any financial decision is based on hard information that can be quantified, such as financial statements and credit history. Due diligence is conducted based on hard information that can be easily verifiable.

Relationship lending is more important for community banks than non-community banks as they invest in long-term relationships with their customers and have the advantage of offering personalized services. The relationship banking approach could help mitigate credit risk as the bank pays more attention to the client and builds close ties with him/her. In that sense, relationship banking encourages better monitoring by the lender and resolves agency and informational problems (Berger et al. 2005; Boot and Thakor 2000). The bank is better able to access the borrower's repayment capability and thus, the bank explores a comparative advantage in lending (Boot 2000). Relationship banking approach smooths the informational asymmetry between borrowers and lenders and thus provides an advantage for community banks in terms of credit risk. Cornée et al. (2012) claim that borrowers' repayment rate is significantly higher when a bilateral relationship between the borrower and the lender exists. This is in line with the notion of "reciprocity", according to which borrowers that consider themselves fairly treated undertake investments with low risk in order to reciprocate the bank's gesture hence lower their probability of default (Cornée and Szafarz 2013). As such, moral hazard issues may appear less pronounced under a relationship banking model. For example, it may be more difficult for a community bank to securitise bad loans in its books. This would give the bank the incentive to better screening and monitoring process.

However, potential threats arise for the bank from engaging into relationship banking approach. The soft budget constrain problem is related to the fact that the bank may lack the toughness in enforcing credit contracts. The firm benefits from building close ties with the lender in the form of increased financing (Petersen and Rajan 1994). The bank may choose to provide further credit to a borrower that is close to default in the hope of recovering a previous loan. This is in line with the notion of "zombie banks", where insolvent banks attempt to remain in business by taking excessive risks in the anticipation that the situation of the borrower would improve

(Acharya et al. 2011). The findings of Elsas and Krahnen (1998) suggest that Housebanks in Germany provide liquidity insurance to the borrowers in cases where his rating deteriorates unexpectedly.

2.2.3 Geographical concentration

The business model of community banks goes beyond their financial profile and relates to their location too. They are prevalent in small towns and rural areas, which make up for most of the US. It is three times more likely for community banks to hold a banking office outside a metro area (FDIC 2012). Moreover, community banks may be at a single location or have a limited number of offices, while the level of deposits that they hold is also commensurate with their network size.

Community banks play a key role in the economy by providing financial services in their local communities. The fact that community banks operate within a limited geographic scope suggests that they hold less diversified portfolios. Portfolio theory suggests that geographically concentrated banks are riskier than geographically diversified banks because they bare higher credit risk. However, evidence from the literature is mixed. Meyer and Yeager (2001) find little correlation between the geographic concentration of the bank offices and its vulnerability to local economic shocks. Alton Gilbert et al. (2013) suggest that community banks that thrived during the GFC were not necessarily concentrated in areas with strong economic growth but were geographically concentrated to areas that are relatively prosperous in agriculture and energy; sectors that were particularly unaffected by the GFC. Yeager (2004) compares the performance of banks located in counties that went through economic shocks in the 1990s with banks in other counties and find that community banks are not systematically vulnerable to local market risk. Community banks hold more diversifiable credit risk than their commercial counterparts because they conduct geographically concentrated business (local market risk) and they are smaller in size (idiosyncratic risk). Emmons et al. (2004) look at the ability of community banks to diversify default risk through geographic diversification and size growth and they find that more risk reduction benefits are achieved by increasing the bank’s size, whereas local market risk is less severe. Similarly, evidence from US banks during the period 2007-2010 suggests that extensive branching across counties does not seem to be associated with lower probability of default (Aubuchon v Wheelock 2010).

2.2.4 Traditional banking approach of Community Banks

Community banks derive most of their revenue from net interest income as they are primarily engaged in the loan-making and deposit-taking business. By contrast, non-community banks are generally more involved in off-balance sheet banking activities, i.e. they have shifted from interest income generating activities to non-interest income. These banks are using off-balance sheet instruments to hedge part of their risk, so overall their exposure to risk is lower. Since non-community banks engage in more sophisticated risk management techniques, the impact of credit risk is less pronounced for this bank group. At the same time, financial innovation has enabled banks to mitigate liquidity pressures. This is more prevalent for non-community banks. On the liability side, they increase their share on wholesale funding and on the asset side they securitise their loans. Those financial innovations allow non-community banks to reduce their reliance on deposits and to convert illiquid loans into cash (Loutskina 2011).

However, additional risk arises from engaging in that type of activities. DeYoung and Torna (2013) suggest that when more investment opportunities are available to a bank, it may opt to incur more risk, so higher involvement in non-traditional banking activities is often associated with lower stability. Gilbert et al. (2013) examine the characteristics of community banks that maintained the highest supervisory ratings during the financial crisis and emphasize that conservative lending and tighter lending standards infused financial stability for community banks.

2.2.5 Ownership Structure

Ownership of community banks is concentrated in the hands of few stockholders who are actively involved in the management of the bank. This implies localized decision making, which is necessary for the relationship banking approach practiced in these banks (Hein et al 2005). In particular, loan officers in community banks should have the flexibility to act independently on the basis of information they have. This relates to the study of Brickley et al. (2003) who finds managers of small banks to have more decision authority. By contrast, Berger and Udell (1995) claim that stockholders of large banks are less eager to allow local managers the authority of decision-making and instead rely on bureaucratic and time-consuming procedures.

The fact that owners are actively involved in the bank's management mitigates agency problems. When the ownership structure of the bank is more concentrated, the owners are able to monitor the managers closely and discipline their risk appetite. Cooperative banks in Europe which are typically owned by their members are found to exhibit higher financial stability than other banks (Cihák and Hesse 2007). These banks focus on preserving their capital base, preventing losses in their portfolio, and maintaining a stable basis of depositors, which could act as protection in periods of distress. Likewise, we would expect managers of community banks to be risk averse.

2.3 Methodology

2.3.1 Insolvency, credit and liquidity risk proxies

We use three main proxies to measure risk, one for insolvency risk, one for credit risk and one for liquidity risk. The description of each variable and its calculation is provided in Table 2.1. We proxy insolvency risk (IR) using the z-score, a widely used proxy for this type of risk (Boyd and Runkle 1993; Cihák and Hesse 2007; Lepetit et al. 2008; Cihák and Hesse 2010; Abedifar et al. 2013). In principle the z-score calculates the number of standard deviations that the bank's return on assets (ROA) must fall below its mean in order to deplete equity. The z-score increases with higher profitability and capitalization levels and decreases with volatile earnings. Therefore, high values of the z-score show financially stable banks with low probability of default. In practice, there are several alternative definitions of the z-score, see Mare et al. (2017) for a comprehensive review. In our study we use the Cihák and Hesse (2007) variant. This measure of the Z-score considers only the last period value for the Equity/Assets and the ROA, while it computes $\sigma(ROA_T)$ over the whole sample period. However, in our robustness tests we also include alternative z-score measure, which we discuss in more detail at section 5.5.1. The z-score can be equally applied to community and non-community banks since these operate in the same environment and face the same risks in case they run out of capital. As the z-score features high skewness we use the natural logarithm transformation, in line with Laeven and Levine (2009).[4]

To proxy credit risk (CR) we use the respective measure of Imbierowicz and Rauch (2014), which is similar to Angbazo (1997) and Dick (2003). The credit risk variable measures the

[4] Another popular measure of insolvency risk is the Distance-To-Default, which uses stock price data to measure the volatility in the economic capital of the bank (Danmark Nationalbank, 2004). However, as most community banks are not listed in a stock exchange, market price data are not available.

unexpected loan default ratio of the bank. It is calculated by dividing the average net loan losses (loan charge-offs minus loan recoveries) in the current year by the average loan loss allowance in the previous year. This measure captures the current riskiness of a bank's loan portfolio and the ability of the bank's risk management to anticipate near-term future loan losses. High values of the CR ratio suggest high credit risk for the particular bank.

In the past studies have focused on the use of CAMEL-type liquidity ratios to measure liquidity risk.[5] However, Poorman and Blake (2005) emphasized that traditional CAMEL-type liquidity ratios do not fully capture the complexities of liquidity risk. Hong et al. (2014) calculate the Basel III liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR) for US banks over the period 2001-2011. However, calculating these measures can be challenging because there exists a gap between historical data and the information required for calculating the LCR and NSFR.

To proxy liquidity risk (LR) we use the respective measure of Imbierowicz and Rauch (2014). The intuition behind the LR ratio is that in case of sudden withdrawals from the bank, the full volume of liabilities may not be liquidated at short notice and/or without substantial cost. Hence the LR proxy subtracts the volume of all assets that the bank can at short-time and low-cost turn into cash from the volume of liabilities that can be withdrawn from the bank on short notice. The LR proxy takes into account the bank's exposure to the interbank lending market and derivatives market as well as off-balance sheet liquidity risk positions through, for example, unused loan commitments. The LR ratio is standardised by Total Assets. Higher values of the LR ratio indicate a bank that is in worse situation to meet unexpected liquidity demand and is therefore subject to higher liquidity risk.

[Table 2.1 around here]

2.3.2 Econometric model

To assess differences in the risk profile of community and non-community banks, we rely on panel robust regressions for each of the three risk measures, namely insolvency risk, credit and liquidity risk. All regressions control for bank type, bank-specific, market structure and macroeconomic factors. We allow for four formulations of each model, hereafter referred to as

[5] See for example Ahmed et al. (2011); Bonfi and Kim (2012)

Models I to IV respectively. The models are increasingly less restrictive by allowing for less similarities between the two bank types. Model I is fitted on all banks and only allows for a level shift in the respective risk quantity by the inclusion of a community bank (CB) intercept dummy. Hence, it implicitly assumes that the sensitivities to control variables are identical for the two bank types. Model II adds interaction terms between the CB dummy variable and the control variables, thus allowing for the sensitivity of the modelled risk quantity to differ between the two banks. Models III and IV are fitted to community banks and non-community banks separately. They can be viewed as unrestricted in the sense that they allow for more differences between the two bank types compared to Models I and II.

For each of the models outlined above we consider two variants. The first relies only upon bank-specific variables sourced from the financial statements. The second further adds market structure and macroeconomic variables. In all estimations we use Huber-White robust standard errors and year and state fixed effects. We estimate the following model:

$$\begin{aligned} y_{i,t} = \alpha + \beta CB_{i,t} + \gamma X_{i,t-1} + \delta M_{i,t-4} + \zeta CB_{i,t} \times X_{i,t-1} \\ + \lambda CB_{i,t} \times M_{i,t-4} + v_i + \varepsilon_{i,t} \end{aligned} \tag{2.1}$$

where i indexes banks, and t indexes the time period in quarters. The dependent variable, y is the z-score for the insolvency risk, the credit and liquidity risk proxies for the respective risk profiles. $CB_{i,t}$ is a dummy variable that takes the value of 1 if the bank is a community bank at time t and 0 otherwise. $X_{i,t-1}$ is a matrix of bank-specific independent variables; $M_{i,t-4}$ is a matrix of variables capturing the macroeconomic and market structure conditions; $CB_{i,t} \times X_{i,t-1}$ is the interaction between bank-specific variables and the community bank dummy; $CB_{i,t} \times M_{i,t-4}$ is the interaction between macroeconomic variables and the community bank dummy; v_i is the unobserved random effect that varies across banks; $\varepsilon_{i,t}$ is an idiosyncratic error term. All variables are lagged one quarter to eliminate any potential endogeneity issues, while GDP growth and inflation are lagged four quarters as generally such variables take longer to reflect on bank operations.

Certain remarks are in place here. From the Liquidity Risk regression, we have excluded the ratio of Net Loans to Total Assets and from the Credit Risk regression the Loan Loss Allowance to Total Loans. This is done because each of these ratios are conceptually related to the dependent variable. The community bank dummy is time dependent because the status of a bank can change in light with the FDIC definition.

2.4 Data

We use unconsolidated data from the Call Reports of US banks, beginning from the first quarter of 1984 till the fourth quarter of 2013. Community bank status is taken from the FDIC and is matched to the Call reports using the FDIC certificate number. The macroeconomic variables are collected from Datastream and the Federal Reserve Bank of St. Louis. Banks with missing or zero assets, equity, loans, deposits and other non-commercial banks are excluded from the original dataset. Also, to avoid any distortion in the ratios, for the banks with equity below 1% of the assets, the equity value is set as 1% of the assets. The sample consists of 20,406 banks and over one million bank-quarter observations. In our sample, 14,394 (70%) of the banks have always been community banks throughout the study period based on the FDIC community bank definition, 2,470 (13%) have always been non-community banks and 3,542 (17%) have changed status between 1984 and 2013. The large sample composition of community banks (at least 70%) is consistent with similar comparative studies and is mainly driven by the small size and local operations of these banks.

2.4.1 Community Bank Dummy Variable

Previous research has simply established an upper assets size threshold-typically $1 billion- in order to define community banks. However, this definition has several deficiencies. First and foremost, it does not take into account factors such as inflation, economic growth or the size of the banking industry. This is particularly relevant for studies like ours that compare distinct bank types across a large time span, as applying a single size criterion may exclude the large community banks or small non-community banks. The FDIC 2012 definition accounts for such factors to impact on bank characteristics. Moreover, it goes beyond a single size criterion and introduces business model criteria. Our community bank dummy is constructed based on this definition. In order for an organization to be classified as a community bank it should have at least 33% in the Loans/Assets ratio and at least 50% in the Core Deposits/Assets to ensure that the bank focuses on traditional deposit-taking/loan-making activities. The organization must have at least one office, but less than an upper threshold that is adjusted over time. Moreover, the organisation can have offices in a maximum of three states and two large metropolitan areas, so as to ensure that the organization operates within a limited geographic scope and can engage in relationship lending. Lastly, the upper level of deposits that any branch can hold is set, which is adjusted over time. Banks that have at least 50% of their assets in specialty organizations, such as credit card specialists, consumer nonbank banks, industrial loan companies, trust companies, banker's banks are excluded from the community bank definition. Excluded are also banks that hold at least 10% of their assets in foreign offices, have no loan making activities and/or take no deposits. The FDIC definition is summarised in the Appendix 2.1.

2.4.2 Explanatory Variables

Empirical literature has shown that most of the financial stability explanatory power comes from bank-specific and macroeconomic variables. We consider key financial ratios, in line with the CAMELS framework. CAMELS proxies have been found to be important determinants of bank failure (Lane et al. 1986; Thomson 1992; Cole and Gunther 1995; Cole and Gunther 1998). In particular, high leverage, low cost efficiency, poor asset quality and low profitability are some of the key characteristics of distressed banks (Wheelock and Wilson 2000).

Capitalisation is proxied by the ratio of Equity / Assets, in line with the studies of Altunbas et al. (2007); Berger and DeYoung (1997); Fiordelisi et al. (2011) and measures the bank's financial cushion to absorb financial losses. Capitalisation is perhaps the single most important metric from a regulator's perspective to the financial health of a financial institution. Asset quality is proxied by the ratio of Loan Loss Allowance/Total Loans. Several studies have used the non-performing loans to total loans (NPL/TL), see for example Berger and DeYoung (1997); Fiordelisi et al. (2011); Dong et al. (2017). Non-performing loans to total loans is less susceptible to managerial discretion compared to loan loss provisions and/or reserves (LLP/TL), see for example the studies of Tan and Floros (2013); Williams (2004); Altunbas et al. (2007) which opt for these proxies mainly driven by data availability issues. We control for earnings quality differences through the Return on Assets (ROA). This ratio, alongside Return on Equity (ROE), is one of the most commonly used to gauge profitability of a bank, see for example Cole and Gunther (1995). The Non-Interest Income / Total Income ratio is included to proxy for income diversification.[6] A bank may diversify its operations away from

[6] We also experiment with the Income Diversity proxy as per Laeven and Levine (2009). Income Diversity is a measure if diversification across different sources of income, computed as 1 - $\left|\frac{(Net\ Interest\ Income - Other\ Operating\ Income}{Total\ Operating\ Income}\right|$ with higher values indicating higher degree of diversification.

the traditional deposit-taking/loan-making and focus on fee-generating sources of income, such as stock broking and/or insurance (Beck et al. 2013). The Cost/Income ratio is a proxy for cost efficiency with poorly run banks having higher costs compared to their income (Cihák and Hesse 2010). Liquidity differences among banks are proxied by the Net Loans/Total Assets ratio. This ratio indicates the percentage of assets that are tied up in loans, which is inversely proportional to bank liquidity as loans are among the least liquid investments. Other studies that use this ratio include Cihák and Hesse (2010); Beck et al. (2013). Bank size differences are captured via the natural logarithm of Total Assets, in line with the literature (Wheelock and Wilson 2000). All monetary values have been deflated using the GDP deflator following Berger and Bouwman (2009). To reduce the impact of outliers in our analysis we winsorize each variable at the 1^{st} and 99^{th} percentile, following Beck et al. (2013).

Macroeconomic and market structure variables are also included in our specifications. To capture the macroeconomic environment, we follow the studies of Cole and Gunther (1995); Cihák and Hesse (2010); Houston et al. (2010); Berger and Bouwman (2013); Schaeck and Cihak (2014) among others. Our macroeconomic controls include: i) real GDP growth; ii) inflation; iii) oil price change; iv) house price change; v) long-term government bond yield. All variables are computed as the quarter-on-quarter logarithmic change in the respective underlying index and are stationary.

The macroeconomic environment plays a catalytic role on bank distress. We adjust for the impact of macroeconomic cycle by including a number of macroeconomic variables. We include the GDP growth to capture the economic growth (Demirgüç-Kunt and Detragiache 2000). High GDP growth improves the bank's survival probability. We also control for the inflation of the economy. High inflation has an adverse effect on bank's stability. High inflation in the early 90s was one of the main factors underlying the elevated probability of crisis in Mexico (Demirgüç-Kunt and Detragiache 2000). Sectoral- specific developments, can have a severe impact on the banking system. Close to the beginning of our sample period, oil prices plunged dramatically. During this time, states with oil dependent economies exhibited higher rates of bank failures. In Texas for example many banks closed as the state went into a recession after declining oil prices. Texas is the second biggest state in terms of population and GDP and it is also the top producer of crude oil in the US. Cole and Gunther (1995) find that banks located in states that were hurt by the energy recession failed earlier than banks located elsewhere. This is particularly relevant for community banks because by operating locally they become more exposed to local economic shocks. So, oil prices may be a barometer of some local economies and particularly in oil-producing states such as Texas and North Dakota. To control for the effects of the oil-price shock of 1986 we include the oil price index in our analysis. Similar is the case of the house price fluctuations of the early 1980s and the late 2000s. In the 1980s, a small percentage of bank assets were exposed to real estate, however by 2008 that percentage more than doubled. Real estate is used as collateral so changes in the real estate prices are likely to affect bank performance, particularly through the evolution of non-performing loans. In addition, as banks get involved in trading and securitisation operations, their exposure to real estate price risk is likely to increase. We control for changes in the real estate prices by including the house price index.

At country level we want to examine the impact that banks' competitive position has on risk profile. To capture the market structure, we use the banking concentration Hirschman-Herfindahl Index (HHI) as well as the state-level community bank share, in line with the studies of Berger et al. (2009); Jiménez et al. (2013); Abedifar et al. (2013); Pappas et al. (2016). We calculate the HHI at state level using total loans, instead of the most popular total assets so as to ensure a level-playing field between the two bank types.[7] A higher HHI would suggest higher degree of market power based on local market loan share. We also use the market share of community banks at each state to measure concentration. The community bank share is calculated as the total loans held by community banks in each state over the total loans in that state at quarter end. A positive coefficient for this variable would suggest that larger presence of community banks enhances risk-adjusted performance at state level.

Appendix 2.2 identifies the explanatory variables that appear in the model and offers a brief definition for each of them.

[7] We do a robustness check with HHI calculated using Total Assets, however the qualitative nature of the results does not change.

2.5 Empirical results

2.5.1 Preliminary Data Analysis

As a preliminary analysis between the two bank types, the bank-specific variables are reported. Table 2.2 gives the main descriptive statistics for the variables used in our analysis. Figure 2.1 shows the time evolution of key ratios for the two bank types.

[Table 2.2 around here]

[Figure 2.1 around here]

A cursory inspection of Table 2.2 shows that the average community bank is about 3 times smaller than the average non-community bank. Due to the new FDIC definition, we observe that the largest community bank manages 22,400 billion USD, much larger than the 1$ billion used in previous studies. Despite their smaller size, community banks are better capitalised than their non-community counterparts as borne out by the higher Equity/Assets ratio (0.1020 against 0.0969 respectively). Community banks' loan portfolios are of superior asset quality, as suggested by the lower Loan Loss Allowance/Total Loans ratio (0.0157 against 0.0190 respectively). In terms of liquidity, community banks are more liquid than the non-community ones, as evidenced by the lower Net Loans/Assets (0.5668 against 0.5988 respectively). By contrast, non-community banks show significantly lower Cost/Income ratios than the community banks (0.8148 against 0.8416 respectively). Non-community banks are also more diversified in their operations as a higher proportion of their income comes from non-interest-bearing sources, such as trading, investment banking and venture capital activities (0.1429 against 0.0906 respectively). With regards to the three risk measures, the unconditional analysis suggests that community banks have significantly higher z-score (21.54 against 19.15 respectively), which suggests that they exhibit superior financial stability. Community banks also show significantly lower credit (23.39 against 38.32 respectively) and liquidity risk (29.50 against 90.04 respectively) as borne out by the respective indicators.

Figure 2.1 shows the time evolution of key ratios. A brief inspection shows that the non-community banks adjustments on certain ratios are more pronounced compared to the community banks around periods of turmoil. In particular during the GFC community banks increased their LLA/TL by 30% while non-community banks by 51%. During the same period, profitability declined by 76% for community banks and by 128% for their non-community counterparts.

The non-interest income/total income ratio also provides interesting reading as it shows that both bank types gradually increase their non-interest income component, however, non-community banks do so at a much faster pace. In particular, while in 1984 about 5% of the community banks' and 8% of non-community banks' income came from non-interest sources, by 2013 this had grown to 14% for community banks and 23% for non-community banks; a 1.8 and 2.8 times-increase respectively. In terms of insolvency risk, community banks have been consistently operating at higher z-score levels throughout the study period. However, in terms of credit and liquidity risk, non-community banks have been outperforming the community ones during the 1980s. The situation changes after the 1990s where community banks operate at lower credit and liquidity risk levels. During the GFC the level of credit risk increased more prominently for non-community banks than community banks (235% against 200%). Liquidity risk exhibits a downward sloping trend for both bank types after the mid-1990s.

Our preliminary analysis of CAMEL(S) ratios and risk proxies support the hypothesis that the community and the non-community banking models are distinct; thus clearly setting the scene for the differentiated profile with respect to insolvency, credit and liquidity risk.

2.5.2 Results on Insolvency Risk

Table 2.3 shows the results of the insolvency risk estimation for Models I-IV of section 2.3.2, and presents estimated coefficients, robust standard errors and standard goodness-of-fit statistics.

[Table 2.3 around here]

Of primary interest is the coefficient of the community bank binary variable. The results of the fairly restricted Model I, which only allows for a level shift in the insolvency risk of the two bank types, suggest that community banks have lower insolvency risk. The more generalised Model II that allows for different sensitivities of insolvency risk to bank-specific, market structure and macroeconomic variables shows that community banks exhibit lower insolvency risk. As such it corroborates further on the different business model and the unique characteristics these banks exhibit. This result is in support of our earlier, unconditional findings and the FDIC (2012) study.

The positive and significant coefficient on Total Assets suggests that large banks are more financially stable by exhibiting lower insolvency risk, however the magnitude of the effect is very small. Calomiris and Mason (2000) suggest that larger banks are better able to diversify their loan portfolio, thus to reduce their asset risk. The interaction of the community bank dummy with total assets suggests that the size effect on insolvency risk is uniform in direction and magnitude across bank types. This suggests that community banks do not seem to derive additional benefits from having a larger asset base, probably because their ability to deliver relationship-based services is associated with their relatively smaller size.

The positive coefficient on the capitalization ratio (Equity/Assets) suggests that better capitalised banks face lower insolvency risk as they are more resilient to economic shocks. Banks with higher capitalisation are better protected against debt overhang problems (Myers, 1977), can withstand adverse economic shocks, therefore they have lower probability of default. The positive coefficient on the interaction of the community bank dummy with the capitalisation ratio suggests that this risk reduction effect is more pronounced for this type of banks. The differentiated impact of capitalisation on financial stability may relate to the regulator's perception about bank risk taking in the two banks. Capitalisation is a major component in the regulator's controlling of bank risk taking. However, it has been documented that, other things being equal, efficient banks exhibit better risk management; hence are more likely to be granted with more room for leverage (Altunbas et al. 2007). Our regression results verify an inverse relation between bank efficiency and insolvency risk for all banks, as suggested by the negative coefficient on Cost/Income ratio and this effect is more pronounced for community banks. Consequently, non-community banks could mitigate their risk exposure either through capitalisation adjustments or through their superior efficiency scores (see also previous section results). By contrast, community banks exhibit lower efficiency hence capitalisation adjustments are a more prominent measure for mitigating risk in these banks, which would partially explain the significant higher magnitude, relatively to the non-community banks.

Loan Loss Allowance / Total Loans exhibits a positive relation with bank insolvency risk suggesting that lower asset quality is harmful for the bank's stability, which is evidenced by the negative coefficient. This suggests that banks set aside more provisions when the quality of their portfolio is poor, a finding that is in line with the literature (Betz et al. 2014). However, when using the generalised Model II, we find that this effect is mainly driven by the community banks, as verified by the respective negative interaction term. This means that asset quality is of crucial importance to the stability of community banks. We argue that the reason for this effect is, in part, due to the securitisation capabilities and practices of the larger non-community banks, which allow them to shift risk exposures inherent in their loan portfolios away from the core bank operations. By contrast, community banks would be less likely to engage in such activities, possibly due to their limited access to capital markets and lack of relevant expertise and/or their closer connection to society. In particular, reputational risk is important for the community banks that operate in local areas and are active in relationship banking practices.

Liquidity is a key determinant of bank stability as it allows banks to withstand unexpected deposit withdrawals and meet payments and margin calls related to their securities investments/trading operations (Calomiris and Mason 2000). We find that the Net Loans / Total Assets ratio enters the regression with a negative coefficient for both bank types, indicating that the higher the loan component in the bank's portfolio the lower the financial stability, a result that has received support in the literature (Wheelock and Wilson 2000). The interaction of community bank dummy with Net Loans to Assets ratio as well as the comparison of Model III and IV coefficients suggest that the liquidity effect on bank stability is important in community banks. This reflects the specialized focus that community banks have on traditional lending activities. At the same time community banks have significantly lower income diversification compared to non-community banks, which limits their ability to tap into capital markets to boost their liquidity, further highlighting the importance of liquidity management in these institutions. Concentration on non-interest income has a different effect on the stability for the two bank types. It comes with a positive coefficient for non-community banks however, for community banks the effect becomes negative. Because of their focus on traditional lending and deposit gathering activities, community banks derive most of their revenue from net interest income. Non-community banks on the other hand have greater success in generating noninterest income from a variety of sources. Higher profitability, as proxied by the ROE, is associated with higher financial stability owing to the positive coefficient. The effect of profitability on financial stability is more pronounced for community banks.

With respect to the macroeconomic environment, real GDP growth enhanced financial stability in the banking sector, while Inflation hampers it. Inflation is particularly relevant for the financial stability of community banks, perhaps a reflection of their investments that are tied to loans in the real part of the economy as well as their more limited income diversification compared to non-community banks. The community banks' financial stability is more heavily influenced by movements of the interest rates, perhaps expectedly as they are more dependent on interest revenue. Non-community banks on the other hand are able to hedge their exposure better and offset adverse changes. Higher oil prices enhance the financial stability of either bank type; however, the effect is more pronounced for non-community banks. This verifies the findings of Cole and Gunther (1995) which suggest that oil price shock is a significant determinant of the bank's survival probability. Non-community banks were hurt by the Energy Recession when there was a falling demand for crude oil. Banking systems in oil dependent states (e.g., Oklahoma, Texas, Wyoming, North Dakota, Alaska and Louisiana) were largely affected, particularly as there was a dense concentration of non-community banks.

In terms of goodness-of-fit measures, we observe that the R^2 statistics reported are close for the variants including bank-specific, macroeconomic and market structure variables and those based solely on bank-specific variables. In particular, the average R^2 is 33.43% for the former and 32.75% for the latter, suggesting that the accounting statement variables carry most of the predictive power.

2.5.3 Results on Credit Risk

Table 2.4 shows the results of the credit risk estimation for Models I-IV of section 2.3.2, and presents estimated coefficients, robust standard errors and standard goodness-of-fit statistics.

[Table 2.4 around here]

Our primary interest focuses on the community bank dummy which in models I and II bears a negative and significant coefficient. This suggests that community banks have superior asset quality compared to their conventional counterparts, *ceteris paribus*. This may be partially explained by the fact that community banks have stronger incentives for screening and monitoring process, as bad loans are more likely to stay in their books and not be securitized. The relationship banking approach of community banks provides the bank with access to soft information about the loan takers that could resolve agency and informational asymmetry problems, which mitigates credit risk.

We find evidence for a significantly negative relationship between capitalization and credit risk for both bank types. However, the effect for community banks is more pronounced suggesting that capitalisation is more effective in reducing credit risk for community banks. This is not surprising as previous research has documented an inverse relationship between capitalisation and risk (Galloway et al. 1997). This is partially due to the moral hazard hypothesis suggesting that thinly capitalized banks respond to moral hazard incentives by taking more risky loans (Berger and DeYoung 1997) or by maintaining their loan supply to existing low-quality borrowers. A negative relationship between cost inefficiency and credit risk for both bank types is also documented. Using commercial banks, (Berger and DeYoung 1997) find mixed evidence on the relationship between cost inefficiency and credit risk, suggesting a trade-off between operating costs and loan performance. Altunbas et al. (2007) suggest that bank efficiency works as an alternative mechanism to capitalisation for credit risk mitigation that banks could rely upon. Our results for commercial banks support this contention. However, community banks' credit risk mitigation is primarily affected by capitalisation. By and large, income diversification enhances credit risk. This is supported by the positive and significant coefficient of non-interest income to total income for both bank types. It is plausible that a bank that does not specialise in a particular line of business may be less careful on the credit control monitoring. The significant and positive interaction term suggests that community banks' credit risk is particularly affected by income diversification attempts.

Macroeconomic factors have an important influence on the likelihood that borrowers pay their debts. In our analysis, we find evidence for a positive relationship between inflation and credit risk which is more pronounced for community banks. Higher inflation weakens the borrowers' ability to service debt payments by reducing their real income and increasing economic uncertainty; hence increase bank's credit risk exposure. A slowdown in economic activity deteriorates non-performing loan performance whereas an expansion of the economy is characterized by lower rates of non-performing loans.

2.5.4 Results on Liquidity Risk

Table 2.5 presents the results of the liquidity risk estimation for Models I-IV of section 2.3.2, and presents estimated coefficients, robust standard errors and standard goodness-of-fit statistics.

[Table 2.5 around here]

Results from models I and II at Table 2.5 show that community banks face more liquidity risk than their non-community counterparts. The business model of community banks that relies on loan making together with the limited access to capital markets for these banks, makes liquidity management a challenge. By contrast, non-community banks are more able to diversify their funding sources and hedge against liquidity shortages. Moreover, non-community banks are better able due to the size and knowhow to offload their balance sheets from illiquid loans via securitisation techniques. This finding is of particular importance due to the increased prominence of liquidity risk management following the Basel III implementation.

Income diversification increases liquidity risk for both bank types, but the effect is less pronounced in community banks. This may be plausibly linked to the maturity transformation role of banks where non-community banks have a wider array of product maturities to manage as opposed to community banks. Our results show a positive relationship between capitalisation and liquidity risk for non-community banks. Better capitalized banks are less incentivised to withhold liquidity. This may be linked to a perception that capitalisation is the key signal for sound bank practices (Vodová 2011). Moreover, banks with high capitalisation need to invest in projects with high yield to compete in terms of profitability with the high leveraged banks. In particular, De Angelo and Stulz (2015) highlight the competitive pressure that commercial banks receive in terms of profitability from the more leveraged shadow banks. As such, it is expected that well-capitalised banks would have lower liquidity so as not to miss on forgone earnings. By contrast, community banks exhibit a negative relationship between capitalisation and liquidity. This may be plausibly linked to the lower competition that these banks face as they operate mainly in local areas, and/or often feature objectives outside the traditional profit maximisation/cost minimisation dogma. GDP growth has a positive impact on liquidity risk. In periods of economic growth banks tend to lend more and thus run down their liquidity buffers, whereas in periods of economic downturn when lending opportunities are not as good they hold more liquidity

2.5.5 Robustness Checks

2.5.5.1 Alternative z-score measures

The z-score measure used in this paper is one of the most widely used insolvency indicators. The z-score combines information on bank profitability (ROA), leverage (Equity/Assets) and risk (standard deviation of ROA) to assess bank's insolvency risk. However, in the empirical literature certain variations in the calculation of the z-score exist. Of particular relevance to our case where a long time span is used are the concerns on stationarity of the bank returns (Lepetit and Strobel 2013). Mare et al. (2017) build on the work of Lepetit and Strobel (2013) by summarizing the current methods for computing the z-score and introducing a novel estimator whose aims at capturing nonstationary stochastic returns.

In table 2.6 the regressions are repeated using a different specification of the z-score, which is given in table 2.1.

Mare et al. (2017) confirm that the effectiveness of this estimator is warranted even when the stationarity assumption of returns is violated. We have cross-checked that the stationarity of the ROA used in the z-score measure is not violated, and we implement the above z-score variant as a further robustness check. We find the results to be consistent with those presented in the main part of the paper. In particular, and as Table 2.6 reports, community banks bear lower insolvency risk.

[Table 2.6 around here]

2.5.5.2 Loan specialisation and risk profile

Over time the community bank lending portfolio has shifted away from retail focus and moved towards commercial focus. Therefore, the majority of community banks offer loans in all five major categories, namely: Residential Mortgages, Agricultural Loans, Commercial and Industrial Loans (C&I), Consumer Loans or Loans to Individuals and Commercial Real Estate Loans (CRE). Construction and Development Loans (C&D) represent an important subcomponent of CRE loans and for this reason is reported separately (FDIC, 2012).

In this section we investigate the marginal contributions of each loan category on the bank's risk profile for community and non-community banks. To do so we include the ratio of each of the loan categories to the total assets. According to Bhattacharyya and Purnanandam (2011), loans associated with inflated assets such as residential mortgages may expose the bank to higher failure risk than loans of other categories. Multi-family mortgages are associated with higher probability of a bank being insolvent, whereas single-family mortgages are either neutral or associated with a lower probability of default (Cole and White 2012). Real estate loans are found to be particularly relevant in predicting bank failure (Cole and White 2012).

We re-estimate equation 2.1 including the loan type contributions as defined above. Table 2.7 report the estimated coefficients and standard errors for these regressions where the dependent variables are the insolvency, credit and liquidity risk respectively. In the first four columns, all banks are pooled together, in the fifth and the sixth only community banks are included and in the last two columns only non-community banks. As previously, each panel has a micro and macro variant. In addition, the interactions of community bank variable with the loan specialty variables are included (Columns 3 and 4). For brevity we only report the explanatory variables that are related to the loan type.

[Table 2.7 around here]

The sensitivity of the z-score to some loan types appears to be different for community and non-community banks. Loans to Individuals appear with a significantly negative coefficient for community banks. The result for community banks is similar to the findings of Cole and Gunther (1995) who find a significant negative coefficient for this type of loans as a determinant of the survival of US banks. Agricultural loans have a significant negative effect on stability for both bank groups, a result that is in line again with the findings of Cole and Gunther (1995). This may reflect the impact of the continuing decline of small family firms in the US since the early 80s. Concentration on commercial and industrial loans has a negative effect only on the stability for community banks.

In terms of credit risk, agricultural loans, commercial and industrial loans and loans to individuals are significantly affecting the banks' credit risk. Higher proportion of agricultural loans increases credit risk for both bank types to a similar extent. A higher percentage of commercial and industrial loans in the loan portfolio decreases credit risk for non-community banks however, it increases risk for the community ones. SMEs make up the majority of borrowers for this type of loans because they rely on this type of financing to fund their operations and they do not have access to credit markets that large companies have. These firms are normally smaller and less established thus making the loans directed to them riskier. A higher percentage of loans to individuals is linked with an increased credit risk for both bank types, however the effect in community banks is more muted, perhaps owing to their relationship lending approach.

With respect to liquidity risk, concentration on different loan specializations, apart from construction and development loans, have a significant effect on liquidity risk for both bank groups. This is to be expected as typically loans in this category come at high maturities; hence require the commitment of funds for extended periods of time. Commercial and industrial loans increase liquidity risk for both community and non-community banks but for community banks the effect is significantly less pronounced. Similarly, loans to individuals increases liquidity risk but for community banks the effect is more muted.

2.5.5.3 Financial stability and banking crises

In this section we investigate the effect of banking crises on the comparative risk profile of community and non-community banks. The subprime lending crisis began in 2007 and interrupted an upward trend in the house prices, the supply of mortgages and consumer loans and an expanding residential construction activity. These trends had fuelled the balance sheet expansion of both bank types and stimulated economic growth in metro and non-metro areas. During periods of distress, community banks were exposed to the same market conditions as their counterparts. Given the differences in their business model, it is important to investigate how they weathered the crises in comparison with non-community banks.

Our model is capturing the sensitivities of community and non-community banks' risk to bank-specific characteristics during periods of banking crises. In order to do so, we use a difference-in-difference setup with a crisis dummy that takes the value 1 in during the periods of banking crises as defined above; zero otherwise. Following Berger and Bouwman (2013) we consider the two banking crises that are relevant to our sample. These are: i) the credit crunch of the early 1990s (from 1990Q1 to 1992Q4) and ii) the subprime lending crisis (from 2007Q3 to 2009Q4).

The rest of the explanatory variables are as defined in the main part of the paper. Of particular importance here are the double-interaction terms between the community bank and crisis dummies as well as the triple-interaction terms between the community bank, crisis dummies and the explanatory variables. Thus, the model is specified as follows:

$$\begin{aligned} y_{i,t} = \ & \alpha + \beta CB_{i,t} + \gamma Crisis_t + \delta X_{i,t} + \zeta CB_{i,t} \times Crisis_t \\ & + \theta CB_{i,t} \times X_{i,t} + \lambda Crisis_t \times X_{i,t} \\ & + \mu CB_{i,t} \times Crisis_t \times X_{i,t} + \nu_i + \varepsilon_{i,t} \end{aligned} \tag{2.2}$$

where the dependent variable $y_{i,t}$ is the insolvency risk, credit risk and liquidity risk proxies for bank i at period t; $CB_{i,t}$ is the community bank dummy variable. $Crisis$ is the crisis dummy variable; $X_{i,t}$ is a vector of bank-specific independent variables; $CB_{i,t} \times Crisis$ is the interaction between the community dummy and the crisis dummy; $CB_{i,t} \times X_{i,t}$ is the interaction between the community dummy and the bank-specific variables; $Crisis \times X_{i,t}$ is the interaction between the crisis dummy and the bank-specific control variables; $CB_{i,t} \times Crisis \times X_{i,t}$ is the triple interaction of the bank and crisis dummy and the vector of bank-specific variables; ν_i is the unobserved random effect that varies across banks but not over time; $\varepsilon_{i,t}$ is an idiosyncratic error term.

Table 2.8 reports the estimated coefficients and standard errors for the triple interaction terms and the interaction between the community bank dummy and the crisis dummy. The dependent variables are the insolvency, credit and liquidity risk and are reported in columns 1, 2 and 3 respectively.[8] The parameter of the triple interaction term is masking the change in the effect that the explanatory variable has on the risk proxy for community banks during crises i.e. how the crisis and the community bank status jointly modify the effect of the independent variable on risk.

[Table 2.8 around here]

Overall, during banking crises the difference in insolvency risk and credit risk for community banks is not significantly different, as evidenced by the statistically insignificant coefficients of the interaction term between community bank and crisis dummy (0.0215 and 0.0196 respectively). With respect to the bank- specific variables, the negative coefficient of the triple interaction of the ratio of Equity to Assets suggests that the beneficiary effect of higher equity is less pronounced during turbulent times for community banks. The positive coefficient on Loan Loss Reserves reduces the negative effect of this variable on the community bank's stability, which suggests that during non-normal times holding more reserves can offer additional protection for the bank. In terms of credit risk, concentration on non-interest income in periods of crises suggests higher credit risk for community banks. In the liquidity risk results, the coefficient of the interaction between the community bank dummy and the crisis dummy manifests higher liquidity risk for this bank group ($\hat{\beta}_{Crisis \times CB} = 0.052^{**}$). There exists a change in the effect of loan loss reserves on liquidity risk, from positive in regular time to negative during crises.

[8] Coefficients of the bank-specific variables, the interactions of the bank-specific variables with the community bank dummy and the crisis dummy are not included in the table for brevity.

2.5.5.4 Three-stage least squares

To eliminate any endogeneity problem from simultaneity bias, we treat all three risks as endogenous by developing the following system of equations, in line with the existing literature (Tan and Floros 2013; Mollah and Zaman 2015). The system of three equations is given below:

$$\begin{aligned} IR_{i,t} = \beta_0 + \beta_1 IR_{t-1} + \beta_2 IR_{t-2} + \beta_3 IR_{t-3} + \beta_4 IR_{t-4} + \beta_5 CR_{i,t} \\ + \beta_6 LR_{i,t} + \beta_7 CB_{i,t} + \beta_8 X_{i,t} \end{aligned} \tag{2.3}$$

$$\begin{aligned} CR_{i,t} = \beta_0 + \beta_1 CR_{t-1} + \beta_2 CR_{t-2} + \beta_3 CR_{t-3} + \beta_4 CR_{t-4} \\ + \beta_5 IR_{i,t} + \beta_6 LR_{i,t} + \beta_7 CB_{i,t} + \beta_8 X_{i,t} \end{aligned} \tag{2.4}$$

$$\begin{aligned} LR_{i,t} = \beta_0 + \beta_1 LR_{t-1} + \beta_2 LR_{t-2} + \beta_3 LR_{t-3} + \beta_4 LR_{t-4} + \beta_5 IR_{i,t} \\ + \beta_6 CR_{i,t} + \beta_7 CB_{i,t} + \beta_8 X_{i,t} \end{aligned} \tag{2.5}$$

where subscripts i, t index banks and quarters respectively. IR denotes insolvency risk (proxied by the Z-score), CR denotes credit risk and LR denotes liquidity risk. CB denotes the community bank dummy variable. The bank-level control variables that are included are the natural logarithm of total assets, the ratio of Equity/Assets, Loan Loss Allowance/Total Loans, Net Loans/Total Assets, ROA, Cost/Income, Non-Interest Income/Total Income and Income Diversity. Year and state fixed effects are included in the model. The system is estimated via three-stage least squares (3SLS) with robust standard errors. We use four lags of the dependent variable in line with the quarterly data structure and following Imbierowicz and Rauch (2014).

Table 2.9 presents estimated coefficients and robust standard errors in parenthesis from the 3SLS estimation. The results confirm that community banks have higher financial stability than their non-community counterparts. The direction and the significance levels for key explanatory variables remain similar to the results reported in the main analysis. However, credit and liquidity risk appear highly interlinked, a result which has also been verified in Imbierowicz and Rauch (2014). The 3SLS results reveal that sensitivities to key explanatory variables, such as capitalisation and profitability, remain qualitatively similar to the main analysis. However, the community bank dummy fails to reach statistical significance levels. We believe this is, in part, driven by two forces. First, community banks are a heterogenous mix comprising both small, highly-specialised banks in their lending operations as well as large, fairly diversified community banks that resemble commercial banks. Second, credit and liquidity risk, although interconnected, share particularly complex relations, as documented in the Imbierowicz and Rauch (2014) study where only after several sample classifications a more clear relationship has been evidenced.

The 3SLS analysis also reveals some interesting results between the contemporaneous relations of the three types of risk. In particular, higher insolvency risk increases both credit and liquidity risk. Higher liquidity risk increases both insolvency and credit risk. Higher credit risk increases insolvency risk but reduces liquidity risk. Our findings here are in line with the findings of Imbierowicz and Rauch (2014) who suggest that both liquidity and credit risk separately increase banks probability of default.

[Table 2.9 around here]

2.6 Conclusion

Evidence suggests that community banks compete effectively with non-community banks. They conduct business in ways that are different from those of non-community banks. They complement the role of those banks by specializing in relationship banking and providing credit to small and medium size businesses. In addition, they serve customers in rural and small metro areas that are not served by large banks.

Our primary aim is to compare the financial risk profile of community and non-community banks in terms of insolvency, credit and liquidity risk and to test whether their risk profile shows similar sensitivity to key bank-specific, market structure and macroeconomic indicators. Our findings corroborate on the different business model that community banks exhibit. The sensitivity to financial risk shows variations among the two bank types. Using z-score regressions and controlling for both bank-specific and macroeconomic indicators, it is found that community banks tend to be more financially stable than non-community banks. More specifically, community banks do not derive additional benefit in terms of insolvency risk from having a larger asset base. The risk reduction effect of higher capitalisation, better asset quality and higher liquidity is more pronounced for community banks. When it comes to the macroeconomic environment, inflation and real GDP growth are particularly relevant for the stability of this bank type. In terms of credit risk community banks to outperform their non-community counterparts. Community banks' credit risk mitigation is primarily affected by capitalisation and income diversification. Their focus on traditional loan making activities and limited access to capital markets causes community banks to bear more liquidity risk. Our results suggest a negative relationship between capitalisation and liquidity and a positive impact of GDP growth on liquidity risk for community banks. Non-community banks have always had an advantage against community banks because they have better access to more sophisticated financial instruments. This creates additional challenges for community banks who need to compete in the same environment with non-community banks. Therefore, the implication of any bank policy should take into consideration the distinct risk profile of the two bank types. Measuring the effect of bank regulation remains a critical issue that poses substantial challenges for the supervisors.

Figure 2.1 Mean Comparison for the two bank types across time

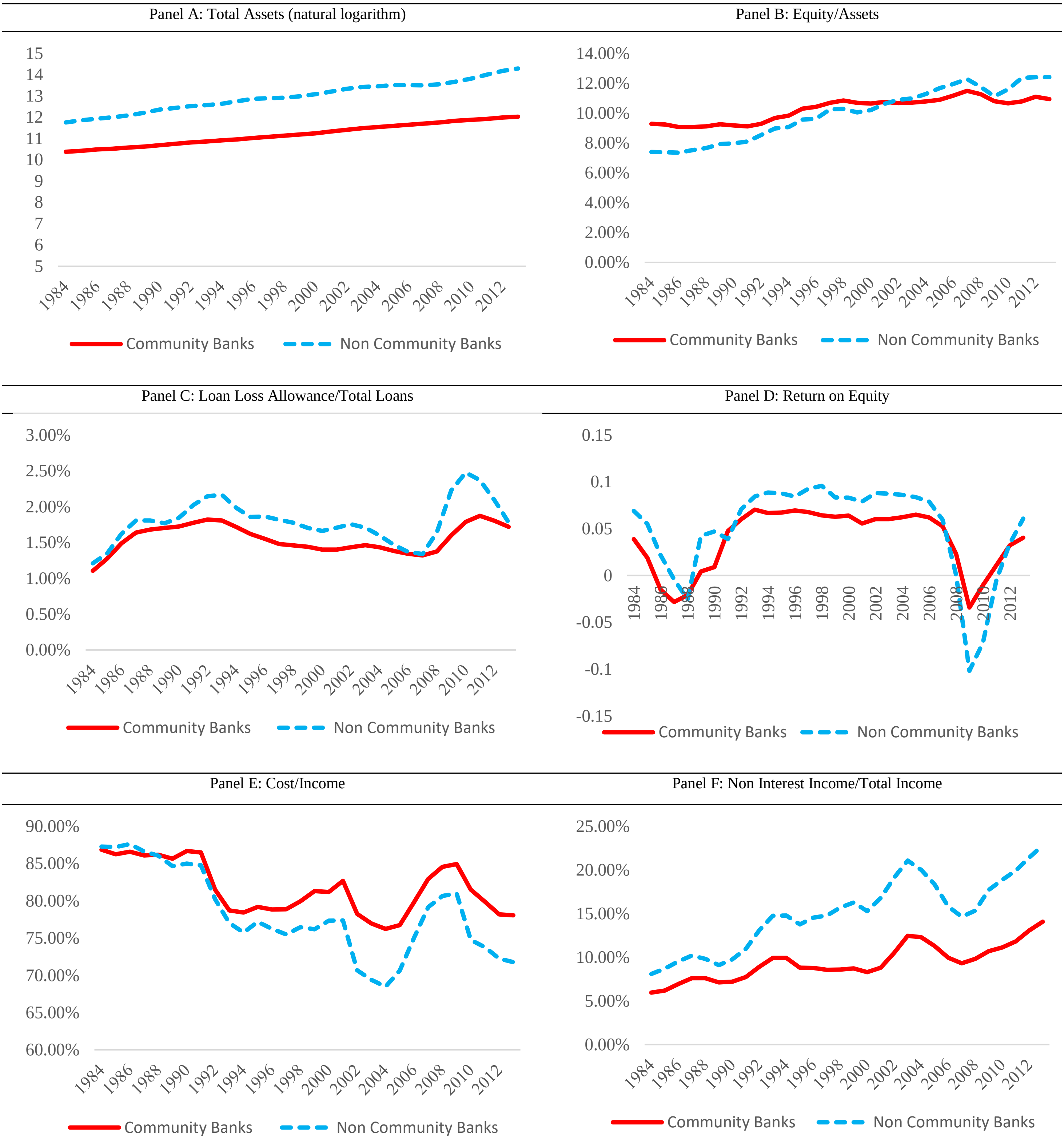
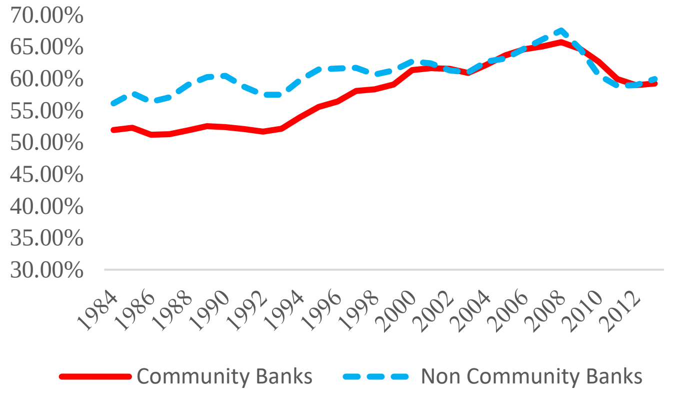
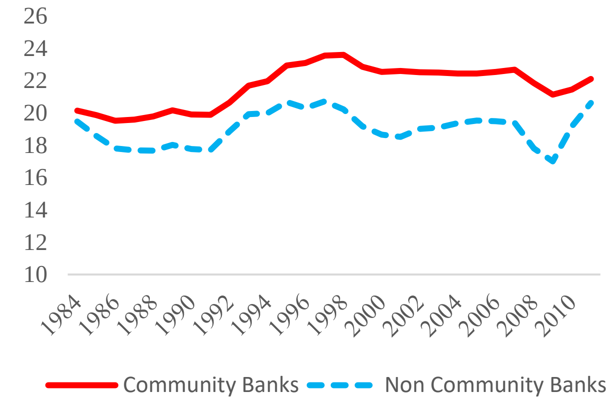


Figure 2.1 (continued)

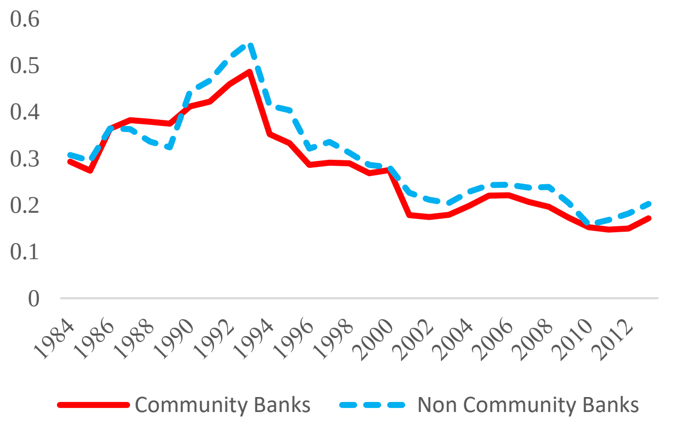
Panel G: Net Loans/Total Assets



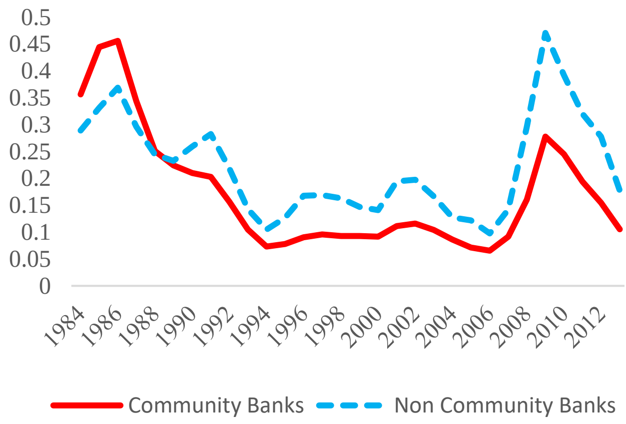
Panel H: Z-score



Panel I: Liquidity Risk



Panel J: Credit Risk



NOTES: Graphs demonstrate the time evolution of key financial characteristics in community and non-community banks. Variables are winsorised at the 1^{st} and 99^{th} percentile.

Table 2.1: Bank insolvency, liquidity and credit risk proxy variables

Category	Proxy	Calculation	Values
Insolvency Risk	Z-score (Cihák and Hesse, 2007)	$Z-score_t = \frac{\frac{Equity_t}{Assets_t} + ROA_t}{\sigma(ROA_T)}$	Higher values indicate higher stability
Credit Risk	Imbierowicz and Rauch (2014) measure (CR)	$CR_t = \frac{Loan\ charge-offs_t - Loan\ Recoveries_t}{Loan\ Loss\ Allowance_t}$	Values above 1 indicate unexpected losses
Liquidity Risk	Imbierowicz and Rauch (2014) measure (LR)	$LR_t = [(\text{Demand Deposits}_t + \text{Transaction Deposits}_t + \text{Brokered Deposits}_t + \text{NOW Accounts}_t + \text{Unused Loan Commitments}_t) - (\text{Cash}_t + \text{Currency \& Coin}_t + \text{Trading Assets}_t + \text{Fed Funds Purchased}_t + \text{Commercial Paper}_t + \text{Securities available for Sale}_t) \pm \text{Net Interbank Lending Position}_t \pm \text{Net Interbank Acceptances}_t \pm \text{Net Derivative Position}_t] \frac{1}{Total\ Assets_t}$	Values above zero imply that the bank is ceteris paribus not able to endure a sudden bank run
Insolvency Risk	Z-score (Mare et al., 2017)	$Z-score_t \equiv \frac{\mu(ROA_T) + EA_t}{\sigma(ROA_T)\bar{\chi}(k-1)/\sqrt{k-1}}$	Higher values indicate higher stability

NOTES: The table displays descriptions and calculations of the three main proxy variables for bank insolvency, liquidity and credit risk, as well as the additional robustness proxy variable for insolvency risk. The Z-score is calculated as the sum of the return on assets and the ratio of equity to total assets divided by the standard deviation of the return on assets. Because of its high skewness, we use its natural logarithm (Laeven and Levine, 2009). It measures a bank's distance to insolvency and it is inversely related to the probability of default. The credit risk proxy is calculated by dividing the net loan charge-offs by the loan loss allowance in the previous year. It indicates the degree to which the current period losses were expected in the period before. The liquidity risk proxy is standardised by total assets and indicates to what degree the bank is able to cover sudden and unexpected liquidity demand with liquid assets.

Table 2.2: Descriptive statistics for the bank- specific variables considered in our analysis

Variable	Obs	Mean	Median	SD	Min	Max
Panel A: All banks						
Total Assets (TA)	1,213,125	683185	67488	15500000	113	1990000000
Equity/Assets	1,213,125	0.1014	0.0907	0.0540	0.0100	0.9986
Loan Loss Allowance/Total Loans	1,213,125	0.0161	0.0132	0.0173	-0.1041	8.0000
Net loans/Total Assets	1,213,125	0.5707	0.5866	0.1590	-0.0045	0.9991
Cost/Income	1,207,006	0.8383	0.8085	1.5946	-143.9091	1470.0000
Non-Interest Income/Total Income	1,207,006	0.0969	0.0783	0.2928	-85.3597	240.7273
ROE	1,213,125	0.0370	0.0555	0.7367	-53.5338	394.0194
Agricultural Loans / TA	1,213,125	0.0512	0.0085	0.0854	0	0.7895
Commercial & Industrial Loans / TA	1,213,125	0.0717	0.0481	0.0862	0	1.8910
Commercial Real Estate Loans / TA	1,213,125	0.3307	0.3100	0.1820	0	1.0093
Construction & Development Loans / TA	1,213,125	0.0314	0.0112	0.0532	0	0.8433
Loans to Individuals / TA	1,213,125	0.0853	0.0637	0.0892	0	1.2044
Residential Mortgages / TA	1,213,125	0.1631	0.1358	0.1277	0	1.1449
Community Bank Share	1,066,649	0.4609	0.4204	0.2346	0.0019	1
HHI	1,213,125	846.5179	477.2381	1032.4680	72.8941	10000.0000
z-score	1,156,825	21.2491	20.5727	12.4040	-49.9342	3208.3040
Credit Risk	1,207,785	0.2519	0.0515	8.3419	-143.0000	6658.0000
Liquidity Risk	1,213,125	0.3680	0.3043	4.4966	-1.5278	1304.7500
Panel B: Community Banks						
Total Assets	1,066,649	137466***	59862***	299177***	284	22400000
Equity/Assets	1,066,649	0.1020***	0.0922***	0.0494***	0.0100	0.9986
Loan Loss Allowance/Total Loans	1,066,649	0.0157***	0.0130***	0.0126***	-0.1041	4.5455
Net Loans/Total Assets	1,066,649	0.5668***	0.5816***	0.1554***	-0.0045	0.9873
Cost/Income	1,060,850	0.8416***	0.8097***	1.6633***	-143.9091	1470.0000
Non-Interest Income/Total Income	1,060,850	0.0906***	0.0758***	0.2908***	-85.3597	240.7273
ROE	1,066,649	0.0353***	0.0547***	0.7711***	-53.5338	394.0194
Agricultural loans / TA	1,066,649	0.0562***	0.0124***	0.0888***	0	0.7376
Commercial & Industrial Loans / TA	1,066,649	0.0685***	0.0451***	0.0837***	0	1.8910
Commercial Real Estate Loans / TA	1,066,649	0.3326***	0.3121***	0.1803***	0	0.9892
Construction & Development Loans / TA	1,066,649	0.0308***	0.0105***	0.0530***	0	0.8433
Loans to Individuals / TA	1,066,649	0.0790***	0.0617***	0.0692***	0	1.1578
Residential Mortgages / TA	1,066,649	0.1640***	0.1365***	0.1269***	0	1.1449
z-score	1,014,292	21.5424***	20.9167***	12.3591***	-49.9342	3208.3040
Credit Risk	1,062,674	0.2339***	0.0459***	4.7365***	-143.0000	2863.0000
Liquidity Risk	1,066,649	0.2950***	0.3002***	0.2449***	-0.9861	54.0211
Panel C: Non- Community Banks						
Total Assets	146,322	4661647	245536	44300000	113	1990000000
Equity/Assets	146,322	0.0969	0.0789	0.0795	0.0100	0.9985
Loan Loss Allowance/Total Loans	146,322	0.0190	0.0142	0.0363	0.0000	8.0000
Net Loans/Total Assets	146,322	0.5988	0.6238	0.1812	-0.0016	0.9991
Cost/Income	146,007	0.8148	0.7993	0.9576	-116.9213	276.0000
Non-Interest Income/Total Income	146,007	0.1429	0.1016	0.3036	-26.3399	72.7638
ROE	146,322	0.0506	0.0639	0.3990	-37.5723	12.8299
Agricultural loans / TA	146,322	0.0144	0.0004	0.0373	0	0.7895
Commercial & Industrial Loans / TA	146,322	0.0946	0.0758	0.0992	0	1.0074
Commercial Real Estate Loans / TA	146,322	0.3166	0.2954	0.1936	0	1.0093
Construction & Development Loans / TA	146,322	0.0356	0.0168	0.0539	0	0.7019
Loans to Individuals / TA	146,322	0.1310	0.0863	0.1693	0	1.2044
Residential Mortgages / TA	146,322	0.1565	0.1305	0.1328	0	1.0083
z-score	142,380	19.1570	18.5577	12.5142	-6.3905	869.5670
Credit Risk	144,960	0.3832	0.0954	20.3793	-63.0000	6658.0000
Liquidity Risk	146,322	0.9004	0.3403	12.9181	-1.5278	1304.7500

NOTES: This table shows the summary statistics for the bank- specific variables used in the analysis. Bank- specific data are retrieved from the WRDS database. Statistics are based on quarterly data from 1984 to 2013. Sample consists of 20,406 banks. Panel A contains all banks in the sample, panel B contains only community banks and panel C only non-community. Assets is expressed in millions USD. Insolvency risk is proxied by the Z-score. Details on how we calculate Z-score, Credit and Liquidity risk proxies are provided in Table 1. All loan categories are calculated as a ratio to total assets. *** denotes statistical significance at the 1% level.

Table 2.3: Regression results (Dependent variable Z-Score)

		All banks				Community Banks		Non-Community Banks	
		Model I		Model II		Model III		Model IV	
Bank Specific	Community Bank	0.001	0.059***	0.123***	0.370*				
		(0.374)	(0.005)	(0.017)	(0.116)				
	Assets	0.001***	-0.001	0.001**	-0.001***	0.001	-0.001	0.001**	0.001**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	Equity/Assets	7.816***	8.017***	7.659***	6.011***	7.810***	8.030***	7.291***	7.272***
		(0.031)	(0.037)	(0.091)	(0.278)	(0.031)	(0.037)	(0.107)	(0.113)
	Loan Loss Allowance/Total Loans	-2.270***	-2.483***	-1.937***	-0.449	-2.341***	-2.510***	-2.294***	-2.362***
		(0.078)	(0.091)	(0.163)	(0.852)	(0.087)	(0.091)	(0.185)	(0.191)
	Net Loans/Total Assets	-0.125***	-0.159***	-0.061***	-0.113***	-0.138***	-0.157***	-0.064***	-0.074***
		(0.004)	(0.005)	(0.010)	(0.040)	(0.004)	(0.005)	(0.013)	(0.013)
	ROE	0.629***	0.639***	0.609***	0.318**	0.630***	0.626***	0.581***	0.570***
		(0.009)	(0.010)	(0.021)	(0.134)	(0.009)	(0.010)	(0.020)	(0.021)
	Cost/ Income	-0.447***	-0.417***	-0.361***	-0.218**	-0.461***	-0.424***	-0.366***	-0.352***
		(0.005)	(0.007)	(0.013)	(0.087)	(0.006)	(0.007)	(0.018)	(0.019)
	Non- Interest Income/Total Income	-0.011	-0.042***	0.099***	-0.014	-0.037***	-0.045***	0.110***	0.111***
		(0.009)	(0.011)	(0.022)	(0.090)	(0.010)	(0.011)	(0.026)	(0.027)
Macroeconomic & Market Structure	Inflation		-0.013***		-0.002		-0.013***		-0.010***
			(0.001)		(0.006)		(0.001)		(0.001)
	Δ(House Price Index)		0.003***		0.004***		0.003***		0.005***
			(0.001)		(0.001)		(0.001)		(0.001)
	Real GDP growth		-0.003***		0.005**		-0.003***		-0.002***
			(0.001)		(0.002)		(0.001)		(0.001)
	Δ(Oil Price Index)		0.012***		0.075*		0.015***		0.001
			(0.001)		(0.040)		(0.001)		(0.003)
	Gvt long term yield		0.011***		-0.007		0.009***		0.004***
			(0.001)		(0.006)		(0.001)		(0.001)
	HHI		-0.001***		0.001		-0.001***		0.001**
			(0.001)		(0.001)		(0.001)		(0.001)
	CB market share		-0.017***		0.037				
			(0.004)		(0.032)				
Community Bank Interactions	Assets×CB			0.001	0.001***				
				(0.001)	(0.001)				
	Equity/Assets×CB			0.174*	1.943***				
				(0.092)	(0.276)				
	Loan Loss Allowance/Total Loans×CB			-0.401**	-2.157**				
				(0.179)	(0.839)				
	Net Loans/Assets×CB			-0.073***	-0.059				
				(0.010)	(0.039)				
	ROE×CB			0.024	0.271**				
				(0.023)	(0.134)				
	Cost/ Income×CB			-0.097***	-0.204**				
				(0.014)	(0.085)				
	Non- Interest Income/Income×CB			-0.134***	-0.029				
				(0.023)	(0.089)				
	Inflation×CB				-0.005				
					(0.006)				
	Δ(House Price Index) × CB				-0.001***				
					(0.001)				
	Real GDP growth ×CB				-0.009***				
					(0.002)				
	Δ(Oil Price Index) × CB				-0.078**				
					(0.039)				
	Gvt long term yield×CB				0.011*				
					(0.006)				
	HHI×CB				-0.001				
					(0.001)				
	CB market share×CB				-0.050				
					(0.032)				
	Constant	1.520***	1.137***	1.409***	0.866***	1.537***	1.050***	2.916***	1.773***
	State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
	Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
	Robust SEs	YES	YES	YES	YES	YES	YES	YES	YES
	Adjusted R^2	0.3307	0.3496	0.3311	0.3499	0.3473	0.3506	0.2100	0.2147
	Observations	1,010,684	812,310	1,010,684	812,310	882,765	809,899	127,919	118,575

NOTES: Table presents regression results for insolvency risk. Assets are deflated using the GDP deflator following Berger & Bouwman (2009). CB denotes the community bank dummy. The dependent variable is the natural logarithm of the Z-score. All variables are lagged one quarter to mitigate endogeneity concerns. Inflation and GDP are lagged by 4 quarters. At each regression we include state and year fixed effects. In the first four columns all banks are included, in the fifth and sixth column we include only community banks and in the seventh and eighth column only non-community banks. Bank-specific variables are winsorized at the 1st and 99th percentile. Robust standard errors are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table 2.4: Regression results (Dependent variable credit risk)

		All banks				Community Banks		Non-Community Banks	
		Model I		Model II		Model III		Model IV	
Bank Specific	Community Bank	-0.020***	-0.040***	-0.047*	-0.278***				
		(0.003)	(0.006)	(0.024)	(0.104)				
	Assets	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	Equity/Assets	-0.477***	-0.570***	-0.174***	-0.244	-0.491***	-0.579***	-0.328***	-0.388***
		(0.026)	(0.032)	(0.063)	(0.212)	(0.028)	(0.032)	(0.068)	(0.071)
	Net Loans/Total Assets	0.292***	0.278***	0.282***	0.284***	0.303***	0.273***	0.220***	0.195***
		(0.007)	(0.008)	(0.015)	(0.048)	(0.008)	(0.008)	(0.018)	(0.018)
	ROE	-0.954***	-0.974***	-0.884***	-0.681***	-0.957***	-0.977***	-0.771***	-0.743***
		(0.010)	(0.012)	(0.023)	(0.139)	(0.012)	(0.012)	(0.023)	(0.023)
	Cost/ Income	-0.135***	-0.112***	-0.188***	-0.0348	-0.115***	-0.113***	-0.0979***	-0.0863***
		(0.007)	(0.009)	(0.021)	(0.067)	(0.008)	(0.009)	(0.022)	(0.024)
	Non- Interest Income/Total Income	0.271***	0.244***	0.375***	0.0772	0.249***	0.247***	0.282***	0.281***
		(0.016)	(0.018)	(0.034)	(0.080)	(0.017)	(0.018)	(0.038)	(0.039)
Macroeconomic & Market Structure	Inflation		0.048***		0.027***		0.048***		0.036***
			(0.001)		(0.008)		(0.001)		(0.001)
	Δ(House Price Index)		0.005***		0.005***		0.005***		0.007***
			(0.001)		(0.001)		(0.001)		(0.001)
	Real GDP growth		-0.016***		-0.023***		-0.016***		-0.019***
			(0.001)		(0.002)		(0.001)		(0.001)
	Δ(Oil Price Index)		0.174***		0.109**		0.174***		0.179***
			(0.002)		(0.049)		(0.002)		(0.005)
	Gvt long term yield		-0.086***		-0.047***		-0.087***		-0.060***
			(0.001)		(0.008)		(0.001)		(0.001)
	HHI		0.001***		0.001		0.001***		-0.001
			(0.001)		(0.001)		(0.001)		(0.001)
	CB market share		0.061***		0.021				
			(0.008)		(0.038)				
Community Bank Interactions	Assets×CB			0.001***	0.001***				
				(0.001)	(0.001)				
	Equity/Assets×CB			-0.340***	-0.325				
				(0.067)	(0.212)				
	Net Loans/Assets×CB			0.010	-0.006				
				(0.016)	(0.048)				
	ROE×CB			-0.078***	-0.294**				
				(0.025)	(0.139)				
	Cost/ Income×CB			0.069***	-0.077				
				(0.022)	(0.067)				
	Non- Interest Income/Income×CB			-0.139***	0.169**				
				(0.036)	(0.079)				
	Inflation×CB				0.020**				
					(0.008)				
	Δ(House Price Index) × CB				-0.001				
					(0.001)				
	Real GDP growth ×CB				0.006**				
					(0.002)				
	Δ(Oil Price Index) × CB				0.065				
					(0.049)				
	Gvt long term yield×CB				-0.039***				
					(0.008)				
	HHI×CB				-0.001				
					(0.001)				
					0.039				
	CB market share×CB				(0.037)				
	Constant	0.446***	0.468***	0.473***	0.152***	0.437***	0.546***	0.171***	-0.198**
	State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
	Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
	Robust SEs	YES	YES	YES	YES	YES	YES	YES	YES
	Adjusted R^2	0.1629	0.1984	0.1631	0.1984	0.1677	0.1982	0.1668	0.1984
	Observations	1,009,632	811,952	1,009,632	811,952	882,080	809,540	127,552	118,304

NOTES: Table presents regression results for credit risk. Assets are deflated using the GDP deflator following CB denotes the community bank dummy. The dependent variable is the credit risk proxy. All variables are lagged one quarter to mitigate endogeneity concerns. Inflation and GDP are lagged by 4 quarters. At each regression we include state and year fixed effects. In the first four columns all banks are included, in the fifth and sixth column we include only community banks and in the seventh and eighth column only non-community banks. Bank-specific variables are winsorized at the 1st and 99th percentile. Robust standard errors are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table 2.5: Regression results (Dependent variable liquidity risk)

		All banks				Community Banks		Non-Community Banks	
		Model I		Model II		Model III		Model IV	
Bank Specific	Community Bank	0.025***	0.006**	0.175***	0.057				
		(0.003)	(0.003)	(0.022)	(0.050)				
	Assets	0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001**	-0.001**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	Equity/Assets	-0.248***	-0.339***	0.221**	-0.083	-0.355***	-0.349***	0.415***	0.392***
		(0.030)	(0.034)	(0.092)	(0.208)	(0.030)	(0.034)	(0.115)	(0.120)
	Loan Loss Allowance/Total Loans	-0.291***	-0.373***	0.894***	-0.883*	-0.489***	-0.293***	0.733***	0.647**
		(0.090)	(0.092)	(0.254)	(0.497)	(0.092)	(0.093)	(0.270)	(0.266)
	ROE	0.023***	0.023***	0.070***	-0.009	0.016***	0.024***	0.020	0.020
		(0.004)	(0.004)	(0.015)	(0.040)	(0.004)	(0.004)	(0.013)	(0.012)
	Cost/ Income	-0.124***	-0.127***	-0.083***	-0.129***	-0.138***	-0.127***	-0.136***	-0.106***
		(0.006)	(0.007)	(0.021)	(0.035)	(0.006)	(0.007)	(0.020)	(0.021)
	Non- Interest Income/Total Income	0.272***	0.251***	0.265***	0.355***	0.237***	0.254***	0.390***	0.421***
		(0.017)	(0.017)	(0.042)	(0.059)	(0.017)	(0.017)	(0.049)	(0.051)
Macroeconomic & Market Structure	Inflation		0.001***		0.001		0.001***		0.001
			(0.001)		(0.003)		(0.001)		(0.001)
	Δ(House Price Index)		0.001***		0.001***		0.001***		0.001**
			(0.001)		(0.001)		(0.001)		(0.001)
	Real GDP growth		0.001*		-0.001		0.001		0.001***
			(0.001)		(0.001)		(0.001)		(0.001)
	Δ(Oil Price Index)		-0.001**		0.013		-0.001***		-0.003**
			(0.001)		(0.021)		(0.001)		(0.001)
	Gvt long term yield		0.001***		0.005*		0.001***		-0.001
			(0.001)		(0.003)		(0.001)		(0.001)
	HHI		0.001***		0.001		0.001***		0.001***
			(0.001)		(0.001)		(0.001)		(0.001)
	CB market share		0.068***		0.082***				
			(0.007)		(0.017)				
Community Bank Interactions	Assets×CB			-0.001***	-0.001***				
				(0.001)	(0.001)				
	Equity/Assets×CB			-0.573***	-0.257				
				(0.094)	(0.207)				
	LoanLossAllowance /Loans×CB			-1.384***	0.515				
				(0.264)	(0.498)				
	ROE×CB			-0.056***	0.033				
				(0.016)	(0.040)				
	Cost/ Income×CB			-0.055**	0.001				
				(0.021)	(0.035)				
	Non-Interest Income/Income×CB			-0.001	-0.106*				
				(0.043)	(0.058)				
	Inflation×CB				-0.001				
					(0.003)				
	Δ(House Price Index) ×CB				0.001				
					(0.001)				
	Real GDP growth ×CB				0.001				
					(0.001)				
	Δ(Oil Price Index)×CB				-0.014				
					(0.021)				
	Gvt long term yield×CB				-0.005				
					(0.003)				
	HHI×CB				0.001				
					(0.001)				
	CB market share×CB				-0.013				
					(0.015)				
	Constant	0.174***	-0.0449**	0.0593***	-0.109**	0.232***	0.0685***	0.377***	0.205***
	State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
	Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
	Robust SEs	YES	YES	YES	YES	YES	YES	YES	YES
	Adjusted R^2	0.2699	0.3058	0.2723	0.3057	0.2990	0.3049	0.2349	0.2387
	Observations	1,010,687	812,310	1,010,687	812,310	882,765	809,899	127,922	118,575

NOTES: Table presents regression results for liquidity risk. Assets are deflated using the GDP deflator following. CB denotes the community bank dummy. The dependent variable is the liquidity risk proxy. All variables are lagged one quarter to mitigate endogeneity concerns. Inflation and GDP are lagged by 4 quarters. At each regression we include state and year fixed effects. In the first four columns all banks are included, in the fifth and sixth column we include only community banks and in the seventh and eighth column only non-community banks. Bank-specific variables are winsorized at the 1st and 99th percentile. Robust standard errors are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table 2.6: Regression results (Dependent variable alternative Z-score estimation)

	All banks				Community Banks		Non-Community Banks	
	Model I		Model II		Model III		Model IV	
Bank Specific								
Community Bank	0.013	0.017	0.218***	0.276				
	(0.008)	(0.010)	(0.077)	(0.247)				
Assets	0.001	-0.001	0.001**	-0.001**	-0.001	-0.001	0.001***	0.001***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	0.001)	(0.001)	(0.001)
Equity/Assets	5.365***	6.090***	6.732***	5.215***	5.112***	6.079***	6.462***	6.727***
	(0.083)	(0.099)	(0.208)	(0.616)	(0.089)	(0.100)	(0.238)	(0.249)
Loan Loss Allowance/Total Loans	-13.890***	-14.770***	-14.670***	-8.9050***	-13.960***	-14.770***	-13.970***	-13.660***
	(0.281)	(0.319)	(0.656)	(1.692)	(0.310)	(0.318)	(0.696)	(0.716)
Net Loans/Total Assets	-0.503***	-0.546***	-0.653***	-0.587***	-0.519***	-0.550***	-0.530***	-0.535***
	(0.018)	(0.020)	(0.046)	(0.083)	(0.019)	(0.020)	(0.050)	(0.053)
ROE	1.620***	1.712***	1.467***	1.870***	1.655***	1.713***	1.399***	1.433***
	(0.022)	(0.024)	(0.058)	(0.223)	(0.024)	(0.024)	(0.056)	(0.055)
Cost/ Income	0.028	0.206***	0.268***	0.468**	-0.004	0.206***	0.004	0.058
	(0.025)	(0.031)	(0.066)	(0.209)	(0.027)	(0.031)	(0.072)	(0.076)
Non- Interest Income/Total Income	-0.587***	-0.551***	-0.824***	-0.748***	-0.564***	-0.550***	-0.682***	-0.709***
	(0.042)	(0.048)	(0.083)	(0.176)	(0.046)	(0.048)	(0.0933)	(0.095)
Macroeconomic & Market Structure								
Inflation		0.009***		0.010***		0.009***		0.021***
		(0.001)		(0.001)		(0.001)		(0.001)
Δ(House Price Index)		0.001***		0.001**		0.001***		-0.001*
		(0.001)		(0.001)		(0.001)		(0.001)
Real GDP growth		-0.008***		-0.006***		-0.008***		-0.003***
		(0.001)		(0.001)		(0.001)		(0.001)
Δ(Oil Price Index)		0.001		0.134		0.001		0.012
		(0.003)		(0.081)		(0.003)		(0.010)
Gvt long term yield		0.025***		0.015		0.025***		-0.007**
		(0.001)		(0.013)		(0.001)		(0.003)
HHI		0.001***		-0.001		0.001***		0.001**
		(0.001)		(0.001)		(0.001)		(0.001)
CB market share		0.0497***		0.066				
		(0.0186)		(0.061)				
Community Bank Interactions								
Assets×CB			-0.001	0.001				
			(0.001)	(0.001)				
Equity/Assets×CB			-1.543***	0.874				
			(0.220)	(0.611)				
Loan Loss Allowance/Total Loans×CB			0.858	-5.842***				
			(0.713)	(1.696)				
Net Loans/Assets×CB			0.169***	0.040				
			(0.047)	(0.082)				
ROE×CB			0.189***	-0.139				
			(0.063)	(0.224)				
Cost/ Income×CB			-0.270***	-0.256				
			(0.068)	(0.209)				
Non- Interest Income/Income×CB			0.284***	0.200				
			(0.0898)	(0.173)				
Inflation×CB				-0.021***				
				(0.001)				
Δ(House Price Index) × CB				-0.001***				
				(0.001)				
Real GDP growth ×CB				0.001***				
				(0.001)				
Δ(Oil Price Index) × CB				-0.132				
				(0.081)				
Gvt long term yield×CB				0.015				
				(0.013)				
HHI×CB				0.001**				
				(0.001)				
CB market share×CB				-0.013				
				(0.059)				
Constant	3.229***	2.314***	3.062***	2.079***	3.289***	2.420***	3.034***	2.663***
State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Robust SEs	YES	YES	YES	YES	YES	YES	YES	YES
Adjusted R^2	0.2142	0.2295	0.2157	0.2296	0.2138	0.2298	0.2075	0.2057
Observations	1,010,677	812,309	1,010,677	812,309	882,762	809,898	127,915	118,571

NOTES: Table presents regression results for insolvnecy risk. Assets are deflated using the GDP deflator following Berger & Bouwman (2009). CB denotes the community bank dummy. The dependent variable is the natural logarithm of the z-score. All variables are lagged one quarter to mitigate endogeneity concerns. Inflation and GDP are lagged by 4 quarters. At each regression we include state and year fixed effects. In the first four columns all banks are included, in the fifth and sixth column we include only community banks and in the seventh and eighth column only non-community banks. Bank-specific variables are winsorized at the 1st and 99th percentile. Robust standard errors are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively

Table 2.7: Regression results on loan specialty

	Panel A: Dependent variable Z-score								
		All banks				Community banks		Non- Community Banks	
		Model I		Model II		Model III		Model IV	
	Agricultural	-0.149***	-0.146***	-0.293***	-0.0598	-0.148***	-0.148***	-0.370***	-0.389***
		(0.018)	(0.019)	(0.048)	(0.142)	(0.019)	(0.019)	(0.080)	(0.080)
	Commercial & Industrial	-0.133***	-0.130***	-0.029	0.106	-0.153***	-0.128***	0.025	0.055
		(0.011)	(0.011)	(0.029)	(0.110)	(0.011)	(0.011)	(0.037)	(0.037)
	Commercial Real Estate	0.010	0.005	0.080***	0.279***	-0.001	0.001	0.055	0.063
		(0.011)	(0.011)	(0.031)	(0.095)	(0.011)	(0.011)	(0.037)	(0.038)
	Construction & Development	-0.066***	-0.058***	-0.134***	-0.429**	-0.063***	-0.058***	-0.095*	-0.133**
		(0.015)	(0.016)	(0.042)	(0.167)	(0.016)	(0.016)	(0.053)	(0.054)
	Loans to Individuals	-0.095***	-0.122***	0.003	0.034	-0.134***	-0.120***	0.069**	0.079**
		(0.013)	(0.014)	(0.028)	(0.109)	(0.014)	(0.014)	(0.035)	(0.036)
	Residential Mortgages	-0.026***	-0.036***	-0.002	-0.011	-0.037***	-0.031***	0.066**	0.059**
		(0.009)	(0.010)	(0.022)	(0.085)	(0.009)	(0.010)	(0.029)	(0.029)
Community Bank Interactions	Agricultural×CB			0.142***	-0.087				
				(0.048)	(0.141)				
	Commercial & Industrial×CB			-0.120***	-0.236**				
				(0.028)	(0.109)				
	Commercial Real Estate×CB			-0.083***	-0.276***				
				(0.031)	(0.095)				
	Construction & Development×CB			0.074*	0.370**				
				(0.043)	(0.166)				
	Loans to Individuals×CB			-0.121***	-0.157				
				(0.030)	(0.108)				
	Residential Mortgages×CB			-0.029	-0.023				
				(0.023)	(0.085)				
	Constant	1.545***	1.442***	1.287***	0.960***	1.567***	1.190***	2.506***	1.826***
	Bank specific	YES	YES	YES	YES	YES	YES	YES	YES
	Macro specific	NO	YES	NO	YES	NO	YES	NO	YES
	State fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
	Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
	Robust SEs	YES	YES	YES	YES	YES	YES	YES	YES
	Adjusted R^2	0.3295	0.3546	0.3302	0.3549	0.3458	0.3554	0.2146	0.2258
	Observations	1,010,684	1,010,684	847,401	847,401	882,765	844,911	127,919	125,259

Table 2.7 (continued)

Panel B: Dependent variable Credit risk								
	All banks				Community banks		Non- Community Banks	
	Model I		Model II		Model III		Model IV	
Agricultural	0.643***	0.592***	0.636***	0.401*	0.620***	0.592***	1.187***	1.211***
	(0.030)	(0.030)	(0.109)	(0.231)	(0.030)	(0.030)	(0.175)	(0.169)
Commercial & Industrial	0.037**	0.119***	-0.138***	-0.004	0.095***	0.118***	-0.162***	-0.132***
	(0.0187)	(0.019)	(0.037)	(0.139)	(0.017)	(0.019)	(0.047)	(0.048)
Commercial Real Estate	0.010	-0.014	0.126***	-0.056	0.007	-0.006	-0.015	-0.036
	(0.018)	(0.020)	(0.042)	(0.121)	(0.019)	(0.020)	(0.048)	(0.050)
Construction & Development	-0.015	-0.046*	-0.196***	0.100	-0.039	-0.049*	-0.044	-0.081
	(0.024)	(0.026)	(0.062)	(0.176)	(0.025)	(0.026)	(0.073)	(0.076)
Loans to Individuals	0.190***	0.150***	0.348***	0.362**	0.134***	0.139***	0.290***	0.253***
	(0.025)	(0.027)	(0.056)	(0.142)	(0.026)	(0.027)	(0.064)	(0.061)
Residential Mortgages	-0.035**	0.014	-0.114***	-0.079	-0.009	0.003	-0.097**	-0.085**
	(0.015)	(0.016)	(0.033)	(0.082)	(0.016)	(0.017)	(0.039)	(0.040)
Agricultural×CB			0.0705	0.263				
			(0.108)	(0.230)				
Commercial & Industrial×CB			0.252***	0.159				
			(0.038)	(0.139)				
Commercial Real Estate×CB			-0.055	0.123				
			(0.044)	(0.121)				
Construction & Development×CB			0.152**	-0.172				
			(0.064)	(0.175)				
Loans to Individuals×CB			-0.179***	-0.195				
			(0.058)	(0.141)				
Residential Mortgages×CB			0.048	0.050				
			(0.035)	(0.081)				
Constant	0.394***	0.501***	0.970***	1.114***	0.393***	1.085***	0.159***	0.237***
Bank specific	YES	YES	YES	YES	YES	YES	YES	YES
Macro specific	NO	YES	NO	YES	NO	YES	NO	YES
State fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Adjusted R^2	0.1628	0.2008	0.1662	0.2030	0.1673	0.2003	0.1788	0.2225
Observations	1,009,632	846,733	1,009,632	846,733	882,080	844,244	127,552	127,552

Table 2.7 (continued)

Panel C: Dependent variable Liquidity risk								
	All banks				Community banks		Non- Community Banks	
	Model I		Model II		Model III		Model IV	
Agricultural	0.283***	0.307***	0.334***	0.619***	0.308***	0.305***	-0.135	-0.131
	(0.023)	(0.022)	(0.075)	(0.068)	(0.022)	(0.022)	(0.097)	(0.095)
Commercial & Industrial	0.158***	0.086***	0.355***	0.207***	0.090***	0.079***	0.296***	0.303***
	(0.014)	(0.014)	(0.034)	(0.043)	(0.014)	(0.014)	(0.046)	(0.044)
Commercial Real Estate	0.372***	0.357***	0.391***	0.384***	0.375***	0.360***	0.338***	0.343***
	(0.013)	(0.013)	(0.036)	(0.042)	(0.013)	(0.013)	(0.048)	(0.049)
Construction & Development	-0.062***	-0.028	-0.041	0.141*	-0.018	-0.032	-0.046	-0.090
	(0.023)	(0.025)	(0.063)	(0.082)	(0.025)	(0.025)	(0.076)	(0.076)
Loans to Individuals	0.291***	0.212***	0.537***	0.309***	0.203***	0.199***	0.515***	0.498***
	(0.017)	(0.017)	(0.037)	(0.047)	(0.017)	(0.017)	(0.044)	(0.044)
Residential Mortgages	-0.128***	-0.146***	-0.024	-0.030	-0.152***	-0.156***	-0.086	-0.092
	(0.016)	(0.017)	(0.041)	(0.051)	(0.017)	(0.017)	(0.058)	(0.059)
Community Bank Interactions								
Agricultural×CB			-0.054	-0.312***				
			(0.074)	(0.065)				
Commercial & Industrial×CB			-0.243***	-0.122***				
			(0.035)	(0.041)				
Commercial Real Estate×CB			-0.019	-0.026				
			(0.036)	(0.041)				
Construction & Development×CB			0.012	-0.169**				
			(0.065)	(0.081)				
Loans to Individuals×CB			-0.321***	-0.097**				
			(0.038)	(0.045)				
Residential Mortgages×CB			-0.135***	-0.117**				
			(0.043)	(0.050)				
Constant	0.0312***	-0.137***	-0.143***	-0.248***	0.123***	-0.0152	0.146**	-0.0272
Bank specific	YES	YES	YES	YES	YES	YES	YES	YES
Macro specific	NO	YES	NO	YES	NO	YES	NO	YES
State fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Adjusted R^2	0.2996	0.3331	0.3089	0.3330	0.3254	0.3319	0.2921	0.3009
Observations	1,010,687	847,401	1,010,687	847,401	882,765	844,911	127,922	125,262

NOTES: Table reports estimated coefficients and robust standard errors in brackets. Further control variables (not shown in the table) are: Community bank dummy, Assets, Equity/Assets, Loan Loss Allowance/Total Loans, Net Loans/Total Assets, ROE, Cost/Income, Non- Interest Income/Total Income, Inflation, Δ(House Price Index), Real GDP growth, Δ(Oil Price Index), Gvt long term yield, HHI, CB market share ***, **, * denote statistical significance at the 1, 5 and 10% level respectively; Assets is expressed in millions USD. CB denotes a community bank. Inflation and GDP have been lagged by 4 periods. Types of loans are calculated as percentage of Total Assets.

Table 2.8: Regression results for the performance of community banks during crises

Dependent variable: Z-score		Dependent variable: Credit Risk		Dependent variable: Liquidity Risk	
(1)		**(2)**		**(3)**	
Crisis×CB	0.021	Crisis×CB	0.019	Crisis×CB	0.052**
	(0.033)		(0.044)		(0.025)
Assets×CB×Crisis	-0.001*	Assets×CB×Crisis	0.001***	Assets×CB×Crisis	0.001***
	(0.001)		(0.001)		(0.001)
Equity/Assets×CB×Crisis	-0.236**	Equity/Assets×CB×Crisis	0.345***	Equity/Assets×CB×Crisis	0.428***
	(0.110)		(0.112)		(0.097)
Loan Loss Allowance/Total Loans×CB×Crisis	0.495*	—	—	Loan Loss Allowance/Total Loans×CB×Crisis	-0.804***
	(0.296)				(0.305)
Net Loans/Total Assets×CB×Crisis	0.041***	Net Loans/Total Assets×CB×Crisis	-0.057**	—	—
	(0.013)		(0.024)		
ROE×CB×Crisis	-0.001	ROE×CB×Crisis	-0.066	ROE×CB×Crisis	0.010
	(0.049)		(0.059)		(0.026)
Cost/Income×CB×Crisis	-0.007	Cost/Income×CB×Crisis	-0.061	Cost/Income×CB×Crisis	-0.006
	(0.028)		(0.042)		(0.026)
Non-Interest Income/Total Income×CB×Crisis	-0.066**	Non-Interest Income/Total Income×CB×Crisis	0.144***	Non-Interest Income/Total Income×CB×Crisis	0.113***
	(0.029)		(0.053)		(0.043)
Constant	1.383***		0.517***		0.0630***
Adjusted R^2	0.3314		0.1645		0.2732
State and Year fixed effects	YES		YES		YES
Robust SEs	YES		YES		YES
Observations	1,010,684		1,009,632		1,010,687

NOTES: Table reports estimated coefficients and robust standard errors in brackets. Interactions with the crisis dummy variables are also included but not reported for brevity. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively; Assets is expressed in millions USD. CB denotes a community bank. Coefficients of the bank-specific variables, the interactions of the bank-specific variables with the community bank dummy and the crisis dummy are included in the model but are not reported in the table for brevity.

Table 2.9: 3SLS Model

VARIABLES	(1) Insolvency Risk	(2) Credit Risk	(3) Liquidity Risk
Insolvency Risk	—	-0.001***	-0.001***
		(0.001)	(0.001)
Credit Risk	-0.929***	—	0.016***
	(0.008)		(0.001)
Liquidity Risk	-0.278***	-0.012***	—
	(0.009)	(0.001)	
Community Bank	0.048***	-0.001	-0.001
	(0.006)	(0.001)	(0.001)
Assets	0.029***	0.001***	-0.001***
	(0.001)	(0.001)	(0.001)
Equity/Assets	7.315***	-0.207***	-0.001
	(0.061)	(0.009)	(0.002)
Loan Loss Allowance/Total Loans	3.195***	—	-0.002
	(0.194)		(0.006)
Net Loans/Total Assets	0.366***	0.076***	—
	(0.013)	(0.001)	
ROE	—	-0.993***	0.057***
		(0.004)	(0.001)
Cost/Income	-1.993***	-0.300***	0.026***
	(0.016)	(0.002)	(0.001)
Non-Interest Income/Total Income	0.930***	0.192***	0.020***
	(0.027)	(0.004)	(0.001)
Constant	1.331***	0.486***	-0.0129***
	(0.030)	(0.005)	(0.001)
Observations	1,120,374	1,120,374	1,120,374
Year Fixed Effects	YES	YES	YES
R-squared	0.971	0.426	0.926
Chi2 p-value	0.000	0.000	0.000
Akaike's information criterion		1811072	

NOTES: Table reports the regression results from a system of structural equations estimated via three-stage least squares. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Further control variables are the first four lags of the dependent variable (not shown in the table). Assets are deflated using the GDP deflator following Berger & Bouwman (2009). Robust standard errors are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Appendix 2.1

FDIC COMMUNITY BANK DEFINITION

EXCLUDE:	INCLUDE:
Organizations with: • 50% or more of their Assets within a specialty organization such as: ○ Credit card specialists ○ Consumer nonbank banks ○ Industrial loan companies ○ Trust companies ○ Banker’s banks • Foreign assets ≥ 10% of Total assets • No loans or no core deposits	Remaining organizations with: • Loans/Assets > 33% • Core Deposits/Assets > 50% • At least one office but fewer than an indexed maximum number of offices* • Offices in no more than 3 states and no more than 2 large metropolitan areas • No single office with deposits above an indexed maximum deposit size* • Total Assets < indexed size threshold* *Adjusted over time ▪ The maximum number of offices was 40 in 1985 and 75 in 2010. ▪ The maximum deposit size per branch was $1.25 billion in 1985 and $5 billion in 2010. ▪ The assets size threshold was $250 million in 1985 and $1 billion in 2010.

NOTES: Source: FDIC. Aggregate charter-level data at banking organization level. If a banking organization is reported as a community bank, every bank under that organization is considered a Community Bank.

Appendix 2.2

DEFINITIONS OF VARIABLES USED IN THE ANALYSIS

Variable	*Definition*	*Type*
Community Bank	Binary variable, equals 1 for community banks; 0 otherwise	Qualitative
Assets	Logarithm of total assets	Balance sheet
Equity/Assets	Ratio of equity capital to total assets	Financial Ratio
Loan Loss Allowance/Total Loans	Ratio of loan loss allowance to total loans & leases	Financial Ratio
Net loans/Total Assets	Ratio of Gross Loans minus Loan loss allowance minus unearned interest to total loans & leases	Financial Ratio
ROE	Ratio of net income to equity capital	Financial Ratio
Cost/Income	Ratio of operating expenses, the mail component of which is salaries to operating income plus interest income	Financial Ratio
Non- Interest Income/Total income	Ratio of noninterest income to total operating income	Financial Ratio
Community bank Share	Ratio of total loans held by Community banks to total banking loans per state and quarter	Market Structure
HHI Index	Computed as the sum of squared market shares (in terms of total loans) per state and quarter	Market Structure
Agricultural Loans	Ratio of agricultural loans to total assets	Financial Ratio
Commercial & Industrial Loans (C&I)	Ratio of commercial & industrial loans to total assets	Financial Ratio
Commercial Real Estate Loans (CRE)	Ratio of real estate loans to total assets	Financial Ratio
Construction & Development Loans (C&D)	Ratio of loans for construction & land development to total assets	Financial Ratio
Loans to Individuals	Ratio of loans to individuals to total assets	Financial Ratio
Residential Mortgages	Ratio of mortgages secured by 1-4 family residential mortgages to total assets	Financial Ratio
Real GDP growth	Quarterly growth of real gross domestic product	Macroeconomic
Inflation	Implicit price deflator, change period over period	Macroeconomic
Oil Price Index	Quarterly growth of crude oil index	Macroeconomic
House Price Index	House price index	Macroeconomic
Gvt. Long-Term Yield	Long-term government bond yield	Macroeconomic

NOTES: Table displays names, definitions and types of the analyzed variables and ratios of the paper's analyses.

Chapter 3 - The efficiency of US community banks

3.1. Introduction

During the 2007 global financial crisis alone, more than 500 US banks failed or received financial support to keep them afloat (Berger and Roman, 2015; Cornett et al., 2013). The vast majority of these banks had less than $10 billion in assets and are commonly referred to as "community banks". The structural changes that the US banking sector has undergone as a result of increasing regulation, uncertainty, integration and financial innovation, have exposed community banks to increased competition (DeYoung et al., 2004). Is the traditional banking model of deposit-taking/loan-making, notably represented by the community banks on the brink of extinction? Or are these "die hard" community banks super-efficient in practicing traditional banking, thus able to stay in the game? The most recent research suggests that users of the traditional banking model are rewarded with a higher propensity to survive against their competitors (Chiorazzo et al., 2018). In this paper we capitalise on these recent findings and push further to investigate the efficiency differences that traditional banking model users enjoy, and how this may explain the enduring presence of the community banks. Ongoing changes in real economy and financial systems highlight the need to adapt regulation accordingly (Claessens, 2017). On the one hand, the increasing regulation is directly related with compliance costs that are a heavy burden on the smallest financial institutions. In particular, sophisticated yet complex in their construction, liquidity ratios mandated under Basel III are becoming the norm, while extra attention is devoted to a special class of financial institutions that are systemically important (SIFIs). On the other hand, despite the transformations that have characterised the US banking industry since the 1980s (i.e., failures, mergers and acquisitions, the shift in banking activities, the opening of interstate branching) and slashed the community banking sector by around 50 percent, community banks still account for the majority of financial institutions (Jacewitz and Kupiec, 2012). Indeed, community banks are the only banking option in many of the under-banked areas of the country (McKee and Kagan, 2018). Moreover, several measures are taken to reduce the ever-increasing regulatory burden of community banks, including simplifying capital requirements and postponing the most sophisticated of the Basel requirements, in light of the prominent role these banks play in their local economies (Bonilla et al., 2018).

Extant research has defined community banks using a single criterion: asset-size. Typically an upper limit of $1 billion in total assets has been used (Feng and Zhang, 2012), while more recently this has been raised to $10 billion to account for technological advances, inflation and the consolidation process (Bonilla et al., 2018; Chiorazzo et al., 2018).[9] However, only defining community banks by a single asset size criterion has several drawbacks. First, community banks are traditional deposit-taking/loan-making financial institutions that abstain from complex financial derivative structures and other exotic investments and focus their operations to the real economy.[10] They are, perhaps, best known for being proponents of "relationship lending" practices. Community bankers have an intimate knowledge and feel of the local community that gives them detailed, soft information on particular aspects of their customers, such as managerial skill and reputation. Central in the production and utilisation of soft information is the role of the loan officer, in part because the quality of soft information deteriorates when transmitted within the financial institution (Becker and Murphy, 1992; Garicano, 2000; Radner, 1993). Because of the complexity entailed in handling soft information, larger and typically non-community banks focus on hard information only (e.g., financial statement lending, fixed asset lending, credit scoring), which can be both easily processed within computer systems and outsourced. Yet, computer-generated credit reports may be overlooked at particular occasions, and more emphasis placed on soft information; thus, affecting loan decisions in a community bank (Liberti and Petersen, 2019). Hence, community banks have more flexibility in their decision making that may give them an advantage in particular lines of business such as agricultural and small-business loans.[11] Due to the differences in the lending technology, community banks may be more likely to maintain such products on the balance sheet instead of shifting them off-balance sheet for securitisation purposes.

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[9] It has been argued that economies of scale are of little importance to the community banking model specifics, with the optimal bank size in the region of only $100-$500 million (Jacewitz and Kupiec, 2012).

[10] For example, only 10% of the US banks with assets between $100 million and $1 billion (i.e., community) used interest rate derivatives (Carter and Sinkey, 1998).

[11] Community banks provide the majority of financing in these categories. Agricultural lending requires knowledge of farming, often very specific to the region, to the farm or to the farmer, and a longer-term perspective as agricultural cycles are fairly long. Relationship lending practices are more relevant in financing of start-up and/or small-businesses where proven track records and collateralizable assets may be hard to come by (Avery and Samolyk, 2004; Holod and Torna, 2018). Real estate lending, particularly for housing, is another business where knowledge of local conditions and borrowers is necessary.

Second, on the funding side community banks are likely to instil a certain loyalty to their depositors who may be less willing to shift to another bank[12], even if their remuneration is below the market rate, as depositors may be attracting a kind of "emotional dividend" from this banking relationship.[13] By contrast, non-community banks have ready access to capital markets, rely largely on fee-based income (e.g., securities brokerage, investment banking, consultancy, underwriting), and operate on the basis of a high volume-transactions based banking model.

Third, it does not capture differences in the geographic scope of operations. Increased geographical distance between firm and bank decreases the likelihood of lending, which is particularly relevant within small business financing (Brevoort et al., 2006; Degryse and Ongena, 2004). Yet research shows that specialised banks may command a certain degree of protection against geographical distance, with customers willing to go that extra mile for peace of mind (Beck et al., 2019).

Fourth, as community banks are often the only banking option outside metropolitan areas they may be better suited to earn high monopoly rents, which can reduce bank risk taking (Keeley, 1990). As far as community banks are not perceived as financially/systemically important they would be less likely to receive too-big-to-fail type of support that may potentially limit their risk taking. However, as they are perceived as economically important for the regions in which they operate, they enjoy preferential access to emergency lending facilities.[14]

Fifth, a single size asset criterion used across a long time span may not properly account for factors such as inflation, economic growth or the size of the banking industry at every point in time. Moreover, bank-type rigidities, differences in adaptation rates to economic environment changes, different goals and priorities can have diverse effects on financial aspects of the two bank types (Kroszner and Strahan, 2014). Consequently, community and non-community

[12] Other alternative banking models are known to instil a particular behaviour in their clients, which has been linked with lower loan default rates (Baele et al., 2014) and loyalty (Beck et al., 2019).
[13] The fact that investors appreciate attributes outside the risk/return dogma, such as social ones is not new – see for example Riedl and Smeets (2017) and references therein.
[14] Ashcraft et al. (2010) present evidence on the role of the Federal Housing Lending Bank (FHLB) in providing liquidity during the global financial crisis both for small and large banks. Banks can opt for FHLB membership and community banks receive certain exemptions on the membership requirements (e.g., a 10 percent rule on residential mortgage loans)

banks share very different business models making it important to comprehensively control for these differences.

To capture the differences in the business models of the two bank types the Federal Deposit Insurance Corporation (FDIC) proposed a new research definition for community banks. This definition goes beyond the single size criterion and captures differences associated with the geographic scope of operations, the access to capital markets, too big to fail subsidies, lending opportunities and lending technology between community and non-community banks. Thus, an array of business model criteria can drive differences in the outcomes. As far as we are aware this is the first study to make use of this new definition to capture the differences in the business model of community and non-community banks.[15]

Building upon this argument, in this study we focus on the business model used by US community banks and compare cost efficiency of community and non-community banks. Banking efficiency studies have long been of interest to a variety of stakeholders.[16] At a macro level, there is some evidence that economic growth is significantly and positively related to banking sector efficiency (Berger et al., 2004). At a micro level, efficiency studies can provide benchmarking information that will be of interest to bank managers and policy makers in order to improve banks' performance. Our approach relies on the Kumbhakar et al. (2014) model, which accounts for unobserved heterogeneity at the bank-level, thereby avoiding the confounding of latent heterogeneity with efficiency. We innovate methodologically by decomposing the cost efficiency into a persistent and a residual component. The cost efficiency decomposition is important by allowing persistent efficiency to reflect market structure, regulatory and supervisory changes across our long observation period, while the residual efficiency captures the usual managerial performance.[17] In addition, we explore the bank

[15] Chiorazzo et al. (2018) construct a traditional index variable that is similar to the FDIC approach. However, they compare survival probabilities within a community bank sub-sample (i.e., all banks are below $10 billion).
[16] The number of citations to Berger and Humphrey (1992) and Berger and Mester (1997), two seminal reviews on banking efficiency, are around 4,200 and 2,600 respectively.
[17] In terms of regulatory changes across our long observation period there are subperiods prior to the Basel Accord, and subperiods when the Basel I/II is in place. An alternative approach of splitting the sample is challenging in terms of identifying which regulation is applicable at each point in time to the community banks given their preferred treatment by the Fed, so as to come up with comparable samples of community and non-community banks. For instance, the capital requirements imposed by Basel II stopped being applied to community banks after the Federal Reserve's proclamation that only the largest US banks would be subject to Basel II and community banks would be subject to Basel I.

specific, macroeconomic and market structure factors that explain differences in the bank efficiency between the two bank types. Disentangling between persistent and residual efficiency and thus identifying the sources of efficiency for US banks can help to select the appropriate course of action. This is important in cases of long time periods, as changes in regulation and market structure typically follow long cycles. Low persistent efficiency may arise from the presence of structural and/or regulatory issues affecting the bank. Enhancing persistent efficiency follows from structural changes in overall banking management practices (i.e., structural reforms) or in the environment where it operates (i.e., government policy or regulatory changes). By contrast, low residual efficiency arises from time-varying factors, such as temporary changes in the economic environment. This type of efficiency is more of a concern at the individual bank-level as it can be increased with short-term adjustments or temporary policy measures.

Our findings reveal that community banks are more cost efficient than their non-community counterparts in terms of overall efficiency and both its components. Community banks have consistently outperformed non-community by 4.91% in overall efficiency, 0.69% in residual efficiency and 4.92% in persistent efficiency across the time span of the study. The managerial skills reflected in residual efficiency are significantly higher in community banks, with the gap to non-community banks closing prior to periods of crisis; possibly reflecting that non-community banks are more susceptible to cost “skimping” behaviour (Berger and DeYoung, 1997). The substantial difference and gradual rise of persistent efficiency for community banks over time is traced to bank- specific developments in the sector, such as the Fed imposing less stringent capital and regulatory requirements for these banks. With regards to key determinants of efficiency we find a negative link between bank size and cost efficiency, with the magnitude being stronger for community banks suggesting that these banks perform better when they are small in size. Non-community banks that are part of a bank holding company exhibit higher cost efficiency, which is linked to the shared economies of scale and scope. By contrast, community banks that participate in bank holding companies exhibit lower cost efficiency, which is plausibly related to the different objectives these banks may be forced to pursue therein. Higher liquidity creation is associated with lower cost efficiency for the community banks; however, the two output measures are positively related for the non-community banks. Financial institutions may maximise cost efficiency for reasons related to combat increasing competition, capitalisation requirements and performance. By contrast, pursuing a strategy that maximises liquidity creation may be more desirable as it would be channelling more funds into the real economy. An implication of our results is that any regulation should take into account the liquidity creation measure besides cost efficiency particularly for community banks. Inflation has a significant effect only for community banks, suggesting that fluctuations in the economic activity affect community banks' efficiency. We repeat our analysis with sample splits based on asset size and financial stability, and our result of higher cost efficiency for community banks remains robust, with the large community banks driving the difference. Further, a positive relation between capitalisation and efficiency is documented for the community banks across both size and risk splits, suggesting that moral hazard behaviour is minimal in these banks. Our results are robust to an alternative specification of cost efficiency, two matching techniques (i.e., k-means nearest neighbour matching and propensity score matching) and different classification of the community banks. The results also hold when we split our sample in four different supervisory regimes that our sample covers.

Our study offers three key contributions to the comparative community and non-community banking literature and the banking efficiency literature. First, the comparative efficiency literature for US community and non-community banks has not comprehensively accounted for the distinct traditional business model in defining community banks. Feng and Zhang (2012) define community banks purely by size, using a $1 billion in assets threshold, while other thresholds have also been used. However, a community bank based on the FDIC definition could be much larger and/or substantially different in operations. Effectively some banks that are classified as community banks under the FDIC are not part of the sample in earlier studies, which limits the generalisation of their findings to the specific business model of relationship lending that community banks practice. Second, we contribute to the US banking efficiency literature by offering the first study to decompose cost efficiency into persistent and residual. Thus, we can disentangle cost efficiency differences related to policy/regulatory/structural changes from managerial capabilities. Most importantly, the decomposition corrects the efficiency estimates for regulatory differences; hence allows us to use a long time span. Third, to the best of our knowledge, this is the first study that investigates the impact of liquidity creation, credit and liquidity risk on cost efficiency. Liquidity creation may be viewed as an alternative output of a financial institution and has been argued to be beneficial to the economy as it allows banks to divert funding to productive uses (Berger and Bouwman, 2009). By investigating in detail the relationship between cost efficiency, credit and liquidity risk in community banks we address the research gap identified by the Fed with regards to the regulatory challenges of these institutions (Bonilla et al., 2018).

The rest of the chapter is organized as follows: Section 3.2 discusses the related literature. Section 3.3 presents the methodology used in this study. Section 3.4 describes our data. Section 3.5 presents the results on efficiency estimates. We test the robustness of our results in section 3.6. Finally, section 3.7 concludes the paper.

3.2 Related Literature

The regulatory changes (e.g., the removal of interstate branching restrictions with the 1994 Riegle-Neal Act), macroeconomic cycles and technological innovations have spurred academic interest in efficiency studies over a changing US banking sector (Berger et al., 1995; Berger and DeYoung, 1997; Evanoff and Ors, 2008).[18] The importance of the consolidation in the US banking sector is apparent in the studies dealing with the efficiency of such institutions over the past few decades. The 1980s consolidation wave showed no efficiency gains for the acquirer banks, while little such gains were evidenced for the acquiring banks (Peristiani, 1997). This may be partially explained by the fact that US banks appear to operate in the optimal size with regards to scale economies (Rangan et al., 1988). Yet, there is evidence that efficiency increases with bank size, albeit at a decreasing rate, which may act as a catalyst towards more consolidation, but at the same time suggests that past a certain bank size, efficiency gains may be negative (Miller and Noulas, 1996). Technological progress that had been ongoing since the mid-1980s gave large banks an advantage over the competition as they could increase quantity and quality of offered services (Berger and Udell, 2002; Elyasiani and Mehdian, 1990). Around this time important is the inclusion of non-traditional activities as an output in the examination of bank efficiency, which had started to become more prominent (Rogers, 1998). It may be plausible that consolidation at this time helped to remove some of the operational inefficiencies (e.g., regulatory rigidities and market structure) that banks were facing (Berger and Humphrey, 1991). The importance of efficiency to the regulators is highlighted in the seminal paper of Eisenbeis et al. (1999) that documents a strong correlation between efficiency and risk taking at the bank level. The study of Altunbas et al. (2007) further suggests that regulators should calibrate the control mechanism so as to take into account the efficiency of individual banks.

[18] Other studies have investigated the impact of this deregulation process on bank risk (Beck et al., 2010; Goetz, 2018; Goetz et al., 2016; Jiang et al., 2017).

Several studies within the banking efficiency literature have compared the efficiency of banks operating under different ownership statuses, and the majority of the results suggest that state-owned banks exhibit lower efficiency scores compared to foreign and/or private banks across both developed and developing economies, such as the US (Mahajan et al., 1996), Australia (Sturm and Williams, 2004), Spain (Garcia-Cestona and Surroca, 2008), Turkey (Isik and Hassan, 2003), China (Ariff and Can, 2008; Fungáčová et al., 2020) and Taiwan (Chen and Yeh, 1998). Only a few studies contradict this result. For example, DeYoung and Nolle (1996) compare foreign-owned to local-owned banks in the US during the 1985-1990 period finding the latter to exhibit higher efficiency. Hauner (2005) finds German and Austrian state-owned banks to be more cost efficient than private banks. The German banking system is known for its uniqueness as government involvement ensures that banks are oriented towards boosting the local and national economy, instead of being purely profit-driven (Behr and Schmidt, 2015). In addition, German universal banks would traditionally offer commercial and investment products under one roof, and also maintain close ties with their largest clients (e.g., house-banks) often through cross-board membership (Elsas and Krahnen, 2003).[19] By contrast, it has been argued that US banks are largely profit-driven and plausibly face significant shareholder pressure to eliminate inefficiencies, which may in part explain the higher efficiency of the US-local banks compared to foreign ones (Altunbas et al., 2007).

A number of studies has also investigated the banking efficiency across the stages of European market integration with mixed findings (Casu and Girardone, 2010; Casu and Molyneux, 2003; Lozano-Vivas et al., 2002). Another strand of research in the banking efficiency literature examine the efficiency based on the nature of the bank; whether it is small or large, specialized or diversified, retail or wholesale (Kwan, 2006). For example, comparison of cost and profit efficiency of financial conglomerates and universal banks in Europe suggests that the universal banks outperform other bank types (Vennet, 1998). Other studies have assessed the performance of Islamic versus conventional banks where the restrictions of the business model in the former adversely impact their efficiency (Johnes et al., 2014).

Although banking efficiency in the US has attracted significant academic attention, little research focuses in community banks even though the variations between the two business

[19] The dominant view is that government involvement in banking leads to inefficiencies due to agency problems, corruption and fraud (Carvalho, 2014; La Porta et al., 2002).

models could suggest significant differences.[20] Indeed, the relative performance of community and non-community banks has evolved differently over time (Hassan and Hippler, 2015). Cole et al. (2004) provide evidence for organizational and operational differences between small and large banks ($1 billion or more in assets) with respect to lending. Large banks rely on hard information- based production technologies whereas small banks tend to rely on soft information-based production technologies and they are often opaque in terms of quantifiable information. For these businesses the relationship lending approach employed by community banks is their main way to get access to credit. In terms of real effects, during periods of crisis, banks that have stronger lending relationships with firms, offer them more favourable continuation conditions and those terms translate into stronger investment and employment growth for the firms (Banerjee et al., 2017). Relationship lending is a key attribute of community banks as the agency problem is more easily resolved by this bank type (Berger and Udell, 2002). Similarly, Berger et al. (2005) suggest that small banks exploit an advantage in soft information production. This advantage may be traced to the incentives that loan officers in such institutions obtain by being able to control and oversee the whole information collection and loan generation and monitoring process (Liberti and Mian, 2008; Stein, 2002).

Feng and Zhang (2012) compare the productivity and efficiency of large banks and community banks in the US over the period 1997 to 2006 by estimating a Bayesian true random effects stochastic distance frontier analysis. Their results indicate higher productivity growth for large banks compared to community banks since this bank group has experienced much higher technical change. They also find that large banks and large community banks exhibit constant returns to scale whereas small community banks exhibit decreasing returns to scale, suggesting that large community banks and non-community banks have been operating at optimal scales, whereas small community banks have not. However, in their analysis they classify community banks as those with assets less than $1 billion so any difference in efficiency performance is really size difference, rather that business model difference. McKee and Kagan (2018) measure the technical efficiency only for community banks and distinguish between small and other community banks; again relying solely on asset size for these classifications. Their findings suggest that in these banks the efficiency is inversely related to the bank size, while key drivers

[20] Virtually no research exists that compares the community banks that rely on the traditional bank business lending model to their counterparts. That is, the majority of the studies arbitrarily define community banks as the smallest of banking institutions.

of efficiency are capitalisation, liquidity and credit risk. Chiorazzo et al. (2018) focus on community banks (i.e., banks with $10 billion or less) and find that those with a more traditional banking model exhibit high survival probabilities.

3.3 Methodology

Efficiency can be measured either by using traditional financial ratio analysis (FRA) or by frontier estimation methods. A drawback of financial ratios is that they do not take into consideration the input prices and the output mix and weights of the ratios are selected subjectively (Berger and Humphrey, 1992). Within frontier estimation methods a bank's observed production point is compared with a production frontier that denotes best practice, with data envelopment analysis (DEA) and stochastic frontier analysis (SFA) being the two principal methods used to estimate the production frontier. Contrary to FRA, the frontier techniques produce an objectively determined efficiency score and accommodate multiple inputs/outputs; thus being better suited to capture the activities of a complex financial institution (Thanassoulis et al., 1996). Central to efficiency studies is the type of the production function, with the majority of studies opting for an intermediary role of the bank, which assumes they act like a wedge between fund surplus and deficit units (Sealey and Lindley, 1977). Technical efficiency is associated with the bank's ability to obtain maximum output with a given set of inputs, allocative efficiency is associated with the bank's ability to use the optimal inputs mix given their prices, whereas cost efficiency is the product of technical and allocative efficiency.[21]

Stochastic Frontier Analysis is particularly well suited to deal with panel data and allows for stochastic errors. A pertinent issue within SFA analysis has been on an appropriate formulation that would on the one hand control for unobserved firm-effects, but on the other hand not confound them with the efficiency estimate. Some models allowed the decomposition of efficiency into two components – a persistent and a residual (Kumbhakar and Heshmati, 1995). However, the unobserved fixed effects were confounded with the persistent, but not the residual

[21] Both technical and cost efficiency measures have been central to several papers (Altunbas et al., 2007; Berger and DeYoung, 1997; Casu and Girardone, 2010; Drake et al., 2006; Lozano-Vivas et al., 2001; Mamatzakis et al., 2015).

efficiency. The Kumbhakar et al. (2014) model decomposes the unobserved fixed effects from the persistent efficiency, while maintaining the residual efficiency component of the earlier models. This essentially allows for a persistent component of efficiency that affects all banks in the sample, while a residual component identifies deficiencies in specific banks. As such, the persistent efficiency is associated with factors that are relatively constant over short time spans, such as structural inflexibilities or regulatory restrictions. The residual component reflects the usual managerial efficiency. However, it allows a bank's efficiency to adjust over time as the bank may eradicate some of the short-term rigidities. Bank heterogeneity, which could be due to different business models and practices, is captured by the firm effects. The model has been adopted by several studies, although not for the US banking sector (Badunenko and Kumbhakar, 2017; Fungáčová et al., 2020; Kumbhakar and Tsionas, 2016).

3.3.1 Cost efficiency estimation

To obtain estimates of cost efficiency we adopt the Kumbhakar et al. (2014) model for three reasons. First, it takes into account the panel nature of the dataset. Second, by including random effects it accounts for unobserved heterogeneity at the bank-level, thereby avoids the confounding of latent heterogeneity with efficiency. Third, the model decomposes cost efficiency into a persistent and a residual component. Persistent efficiency may be attributed to factors that remain relatively constant on a short time- period, such as regulatory changes, structural rigidities, and business/management practices. These are factors that need to be accounted for when long time periods are concerned. Additionally, due to the closeness of community banks to the local community they may be pursuing goals outside the strict profit-maximisation/cost-minimisation dogma. Residual efficiency captures the time-varying efficiency that is specific at the bank level.

We start with a standard cost function that in a panel data specification may be specified as:

$$\ln c_{it} = \alpha_0^* + f\ (y_{it} w_{it};\ \beta) + \alpha_i + \varepsilon_{it} \tag{3.1}$$

where $i = 1, \dots, N$ denotes the bank and $t = 1, \dots, T_i$ denotes the time period during which bank i is observed, c_{it} are the total costs, y_{it} the vector of outputs, w_{it} the vector of input prices, $f(\cdot)$ the cost function, α_i is the random effect for bank i and ε_{it} is the stochastic error term for bank i at time t. In addition, the following quantities are defined:

the constant is $\alpha_0^* = \alpha_0 - E(\eta_i) - E(u_{it})$; the $\alpha_i = \mu - \eta_i + E(\eta_i)$; and the $\varepsilon_{it} = \nu_{it} - u_{it} + E(u_{it})$. This ensures that α_i and ε_{it} have zero mean and constant variance.

The Kumbhakar et al. (2014) model splits the error term into four components, taking this way into account different factors affecting the output given the inputs. The first component is firm's latent heterogeneity which is disentangled from the inefficiency effects, the second captures time-varying inefficiency, the third is time invariant inefficiency and the last component captures random shocks. The model may be rewritten as:

$$\ln c_{it} = \alpha_0 + f\ (y_{it} w_{it};\ \beta) + \mu_i + \nu_{it} - \eta_i - u_{it} \tag{3.2}$$

This model has four components, $\eta_i > 0$ and $u_{it} > 0$ are inefficiency and μ_i and ν_{it} are bank random effects and noise respectively.

To estimate the model in (3.2) we follow the three-step procedure. In the first step a standard panel random effects regression is used to estimate $\hat{\beta}$ from equation (3.1) and the predicted values $\hat{\alpha}_i$ and $\hat{\varepsilon}_{it}$. In the second step estimates of time-varying cost efficiency (u_{it}) are obtained via a standard SFA on ε_{it} of step 1. Specifically, we estimate the equation outlined below as a standard SFA assuming $\nu_{it} \sim iidN(0, \sigma_\nu^2)$ and $u_{it} \sim N^+(0, \sigma_u^2)$

$$\varepsilon_{it} = \nu_{it} - u_{it} + E(u_{it}) \tag{3.3}$$

This step gives prediction of the time-varying residual cost inefficiency components $\hat{u}_{it}$. In step 3 estimates of the persistent cost efficiency η_i are obtained via a standard SFA on α_i of step 1. Specifically, the following equation is estimated as a standard SFA assuming $\mu_i \sim iidN(0, \sigma_\mu^2)$ and $\eta_i \sim iidN^+(0, \sigma_\eta^2)$.

$$\alpha_i = \mu_{it} - \eta_i + E(\eta_i) \tag{3.4}$$

Finally, the overall cost efficiency is calculated as the product of persistent and residual cost efficiency, namely: $OCE = PCE \times RCE$. For the cost function we adopt the following translog cost specification:

$$\ln\left(\frac{TC}{p3}\right) = \beta_0 + \sum\nolimits_{m}(\theta_m lny_m) + \sum\nolimits_{n}\left(\beta_n ln\frac{p_n}{p_3}\right) + \frac{1}{2}\sum\nolimits_{m}\sum\nolimits_{j}(\theta_{mj} lny_m lny_j) + \frac{1}{2}\sum\nolimits_{n}\sum\nolimits_{k}(\beta_{nk} ln\frac{p_n}{p_3} ln\frac{p_k}{p_3}) + \sum\nolimits_{n}\sum\nolimits_{m}(\gamma_{nm} ln\frac{p_n}{p_3} lny_m) + \mu_i + \nu_{it} - \eta_i - u_{it} \tag{3.5}$$

This model builds upon previous panel data models in numerous ways. First, it captures factors with permanent effects on efficiency by including the persistent component. Second, previous models assume that a firm's efficiency at any particular point in time does not depend on its previous level of efficiency. However, some factors affecting efficiency can stay with the firm over the long run while others can be removed in the short run. These are captured by the residual component and the persistent component. Third, it improves upon previous models (Chen et al., 2014) by distinguishing between firm heterogeneity and long-run inefficiency (Kumbhakar et al., 2015). We include time dummies to capture technological progress and varying business cycle conditions. We estimate a pooled frontier to ensure a level playing field for both banks types, since both banks operate in the same market and compete for the same clients.

3.3.2 Second-stage regression

In a second stage we explore the determinants of cost efficiency in community and non-community banks. To do so we regress cost efficiency on a set of bank-specific, market-structure and macroeconomic variables. Using the overall cost efficiency measures derived from the previous stage as the dependent variable, we then estimate the following equation:

$$y_{it} = \alpha + \beta CB_{it} + \gamma X_{it} + \delta M_{it} + \theta Z_{it} + \zeta CB_{it} \times X_{it} + \lambda CB_{it} \times M_{it} + \mu CB_{it} \times Z_{it} + \varepsilon_{it} \tag{3.6}$$

where *i* indexes banks, and *t* indexes the time period. The dependent variable, *y* is the overall cost efficiency score derived from the first step. CB_{it} is a dummy variable that takes the value of 1 if the bank is a community bank at time t and 0 otherwise. X_{it} is a matrix of bank-specific independent variables; M_{it} is a matrix of variables capturing the market structure; Z_{it} is a vector of variables that capture the macroeconomic environment; $CB_{it}\times X_{it}$ is the interaction between bank-specific variables and the community bank dummy; $CB_{it}\times M_{it}$ is the interaction between macroeconomic variables and the community bank dummy; $CB_{it} \times Z_{it}$ is the interaction of the community bank dummy and the economic environment variables; ε_{it} is an idiosyncratic error term.

We estimate equation 3.6 using Tobit regression and we include state and time fixed effects. The use of Tobit is appropriate due to the fact that efficiency scores are bounded between zero and one, so the use of a limited dependent variable model is required. Huber/White standard errors and covariances are calculated to account for heteroscedasticity. The sign of the coefficients indicates the direction of the influence. We allow for two formulations of the model, hereafter referred to as Models I and II, with the first controlling for bank-level characteristics while the second adding market structure and macroeconomic variables. Both models are fitted on all banks, using a community bank intercept and slope dummies, and separately on community and non-community banks.

3.4 Data and variables

3.4.1 Data sources, inputs and outputs definitions

We use quarterly data starting from 1984Q1 to 2013Q4, extracted from the Call Reports of US banks. The Community bank dummy is taken from the FDIC and is matched to the Call Reports using the FDIC certificate number, which uniquely identifies every bank in our sample. By the FDIC classification, the focus of a community bank is upon traditional activities, most obviously that of making loans and taking deposits. A community bank must have respectively 33% and 50% or more of its assets within Loans/Assets and Core Deposits/Assets ratios. A community bank cannot hold 50% or more of its assets with specialty organizations, such as credit card specialists, industrial loan companies and trust companies; it cannot be a bankers' bank; and it cannot hold 10% or more of its assets in foreign offices. A community bank's offices must be located in no more than three states and two large metropolitan areas; and the activity of any given branch is constrained by a time-adjusted upper limit of deposits.[22] We exclude those banks where no data are available for the efficiency estimation. We include banks with a minimum of 3 years of information in line with Beck et al. (2013a). Our combined

[22] The full FDIC Community bank definition is given in the appendix table A3.1.

dataset is an unbalanced panel dataset consisting of 20,099 banks and over one million bank-quarter observations.

We assume the banks act as intermediaries between fund surplus and deficit units and assumed to produce loans (y1) and securities (y2) that constitute the outputs. The input variables are the price of labour (p1) defined as the salaries and employee benefits over the number of full-time equivalent employees, the price of capital (p2) defined as expenses on premises and fixed assets over premises and fixed assets and the price of funds (p3) defined as total interest expenses over total deposits. We define total cost as the sum of total interest expense and total non-interest expense.[23] All monetary variables have been deflated using the GDP deflator.

Table 3.1 summarises the main descriptive statistics for the input and output variables used in the analysis, for the full sample (Panel A), community banks (Panel B) and non-community banks (Panel C). Differences in the choices of input mix are reported between the two bank types. The average price of labour takes the value of 23.892 for community banks and 25.212 for non-community. The average price of capital takes the value of 0.269 for community banks and the value of 0.559 for non-community banks. Referring to the output prices, the average values for both outputs are significantly higher for non-community banks, with the average price of loans being 31 times larger for non-community banks and the average price of securities 22 times larger for non-community.

[Table 3.1 around here]

3.4.2 Second-stage variables

We investigate the determinants of community banks' efficiency in a second-stage analysis[24]. We employ both bank-specific, market structure and macroeconomic variables. Specifically, we include the natural logarithm of bank assets to account for bank size differences as community and non-community banks are significantly different in terms of size. Research so far has found inconclusive results on the relationship between bank size and efficiency, so no *a priori* hypothesis is formed (Bonin et al., 2005; Hauner, 2005; Kwan, 2006). Large banks

[23] The choice of input and output variables is in line with the literature in this field (Casu and Girardone, 2010; Casu and Molyneux, 2003; Drake et al., 2006; Fukuyama and Matousek, 2017; Johnes et al., 2014; Matousek et al., 2015).

[24] We include in our analysis explicitly banks with more than three years of data. Hence, the minimum number of years that a bank exists in our sample is 3 and the maximum is 30.

may exhibit superior cost efficiency because they exploit economies of scale and scope. Small banks may be more flexible in their operations; hence more cost efficient. The link between efficiency and bank size is also argued to be non-linear in alternative types of banks. For example, Johnes et al. (2014) find that Islamic banks outperform their conventional counterparts in terms of efficiency when they are small, but once they grow past a certain size, differences are no longer significant.

We proxy for the bank's funding mix by including the ratio of total deposits to total assets. Deposits are a central component of the traditional banking model. Community banks are particularly reliant on deposits due to their local operations, size and limited financial expertise. Relatedly, Kwan (2006) finds a negative relationship between technical efficiency and deposit to assets, but the relationship is significant only for small banks.

To account for differences in assets quality we include the ratio of loan loss allowance to gross loans. The quality of a bank's loan portfolio may affect bank performance. Banks that provide more loans are exposed more heavily to credit risk, thus an inverse relationship between this variable and efficiency is expected. To proxy credit risk we use the respective measure of Imbierowicz and Rauch (2014). The credit risk proxy measures the unexpected loan default ratio of the bank and is calculated by dividing the average net loan losses (loan charge-offs minus loan recoveries) in the current year by the average loan loss allowance in the previous year. This measure captures the current riskiness of a bank's loan portfolio and the ability of the bank's risk management to anticipate near-term future loan losses. High values of the credit risk ratio suggest high credit risk for the particular bank; thus we expect a negative relationship between this variable and efficiency.

As common for banking studies we measure capitalization by equity to assets. We expect a positive relationship between capitalization and efficiency because lower capital could lead to higher risk-taking and greater leverage, thus lower efficiency (Casu and Molyneux, 2003). To proxy for liquidity risk we use the respective measure of Imbierowicz and Rauch (2014). The intuition behind this ratio is that in case of sudden withdrawals from the bank, the full volume of liabilities may not be liquidated at short notice and/or without substantial cost. Hence the liquidity risk variable subtracts the volume of all assets that the bank can at short-time and low-cost turn into cash from the volume of liabilities that can be withdrawn from the bank on short notice. It takes into account the bank's exposure to the interbank lending market and derivatives market as well as off-balance sheet liquidity risk positions though, for example, unused loan commitments. The ratio is standardised by total assets with higher values of the liquidity risk ratio indicating a bank that is in worse situation to meet unexpected liquidity demand. Profitability is proxied by the return on equity (ROE) ratio. More efficient banks earn higher profits so we expect a positive relationship between this variable and efficiency (Mester, 1996).

To proxy financial stability, we employ the z-score that is commonly used in the banking literature, see for example Laeven and Levine (2009). In principle the z-score calculates the number of standard deviations that the bank's return on assets (ROA) must fall below its mean in order to deplete equity. The z-score increases with higher profitability and capitalization levels and decreases with volatile earnings. Therefore, high values of the z-score indicate more financially stable banks and thus we expect a positive link between this variable and efficiency. In our study we use the Hesse and Cihak (2007) variant, where the z-score considers only the last period value for the Equity/Assets and the ROA, while it computes $\sigma(ROA_T)$ over the whole sample period. As the z-score exhibits high skewness we use the natural logarithm transformation, in line with Laeven and Levine (2009).[25]

The cost to income ratio is often regarded as a proxy for cost efficiency, alternative to the frontier estimation techniques, with a key characteristic being that the ratio relies solely on income statement information.[26] Consequently, cost to income is expected to be negatively related to cost efficiency, as high values of the ratio denote a more inefficient bank.[27]

Cost efficiency has been a well-established measure of bank performance, capable of capturing the complex structure of financial institutions. However, cost efficiency does not take into account the liquidity transformation process in which a financial institution engages, whereby transforming liabilities to assets. The liquidity creation measure (Berger and Bouwman, 2009) may, therefore, be viewed as an alternative output measure that acknowledged this important process of a financial institution. Berger and Bouwman (2015) argue that two equally sized financial institutions may have different priorities; one directing its output towards securities, the other towards loans. The liquidity creation measure would favour the latter due to the fact

[25] In practice, there are several alternative definitions of the z-score, see Mare et al. (2017) for a comprehensive review. As a robustness we compute alternative z-score measures and the results remain qualitatively similar.
[26] See for example Beck et al. (2013b) for a financial ratio application that proxies for cost efficiency.
[27] Table A3.2 in the appendix summarises the formulas for credit risk, liquidity risk and financial stability proxies.

that it would be directing more liquidity into the real economy. We are looking at whether and how the amount of liquidity created by the bank affects the cost efficiency. To do so, we employ the “catfat” measure of liquidity creation, as developed by Berger and Bouwman (2009). This measure classifies assets based on their liquidity attributes and includes off-balance sheet activities in its calculation.

As community banks are primarily loan makers, we investigate the impact of the loan portfolio composition on the cost efficiency by including the ratio of the six main loan categories to total assets; namely i) residential mortgages; ii) agricultural loans; iii) commercial and industrial loans (C&I); iv) loans to individuals; v) commercial real estate loans (CRE); and vi) construction and development loans (C&D). Most community banks hold diversified loan portfolios with engagement in more than one of these loan sub-categories. By including these sub-categories, we gain useful insights as to how the different lending strategies employed by community banks affect efficiency performance.

Community banks provide financial services to a market segment with limited financial opportunities. Changes in the macroeconomic environment that impact the banking sector may have a more pronounced effect in geographical locations with high presence of community banks, which are known to be particularly affected by inflation dynamics (Bonilla et al., 2018). This raises the question of how community banks respond to macroeconomic instability and regulatory changes compared to non-community banks. To account for the overall economic activity, we include the real GDP growth and inflation. Changes in the macroeconomic performance can influence banks differently depending on their cost structure. Banks with higher ratio of interest expenses are more likely to incur losses during economic downturns (Hauner, 2005).

We take into account periods of crisis by including a crisis dummy that takes the value 1 during periods of banking crises as defined above; zero otherwise. Following Berger and Bouwman (2013) we consider the two banking crises that are relevant to our sample. These are: i) the credit crunch of the early 1990s (from 1990Q1 to 1992Q4) and ii) the subprime lending crisis (from 2007Q3 to 2009Q4).

Uncertainty characterises a wide array of decisions including consumer spending and saving patterns, firm expansionary projects, investment decisions and asset allocation, and government policies. Early studies (Bernanke, 1983; Dixit and Pindyck, 1994) identified that imprecisions in forecasting future events are inherent in financial market operations, and may echo in the real economy through the dampening of the general investor confidence; thus, further aggravating the crisis – an effect particularly pronounced during the 2008 Global Financial Crisis (GFC). A new category of uncertainty indicators that emerged, in part aided by these financial crises, aims to capture unique aspects of the economic system that relate to the, typically latent, uncertainty factor. The news-based Economic Policy Uncertainty (EPU) index is constructed using textual analysis on a wide range of newspapers for a variety of terms that relate to economic news (Baker et al., 2016).[28] We take the natural log of the EPU index, with higher values suggesting greater uncertainty.

3.4.3 Descriptive Statistics

Descriptive statistics of the bank financial characteristics are reported in Table 3.2. The average value of bank assets (in natural logs) is 11.095 for the community banks and 12.743 for the non-community; a significant size advantage for the non-community banks that is in line with our expectations. Deposits to assets are at 86% for the community banks and 79% for the non-community banks, corroborating the view that the former are more reliant on deposit funding, with the latter capable to attract more funding from capital markets. With respect to profitability, the mean value of ROE is significantly higher for the non-community banks compared to the community (5% against 3% respectively), which conforms to our expectations that the latter are not primarily focused on profit maximisation. Community banks are significantly more capitalised compared to the non-community counterparts (10.2% against 9.7% in Equity/Assets respectively).

In terms of financial stability, community banks appear to perform better, with the average value of z-score around 2.91, significantly higher compared to the non-community banks, which stand at 2.76, on average. In addition, community banks have significantly lower credit risk compared to the non-community banks (0.23 against 0.36 respectively), plausibly due to their relationship lending approach that is known to reduce moral hazard and adverse incentives (Boot, 2000). Liquidity risk is lower in community banks compared to the non-community (0.29 against 0.90 respectively), which may be linked to the fact that the former have limited

[28]Information on how policy uncertainty index is constructed can be found here http://www.policyuncertainty. com/methodology.html

access to money markets to attract emergency funding; hence are required to rely more on internal mechanisms for liquidity management.

The cost/income ratio is significantly higher for community banks, which may be reflective to the proportionally higher personnel costs of these banks as they rely on expensive labour to carry out credit checks and loan monitoring, whereas the larger non-community banks have turned to a mix of computers/low-skilled personnel. Substantial differences exist between the loan portfolios of the two bank types. Commercial real estate loans constitute the highest proportion of the loan portfolio for both bank types (33% for community banks and 32% for non-community). Commercial and industrial loans account for 6% on average of the community banks' portfolio and 9% for that of the non-community.

[Table 3.2 around here]

3.5 Empirical results

3.5.1 Cost efficiency results

Estimates of the overall cost efficiency and the two decompositions, persistent and residual, are presented for community and non-community banks in Table 3.3 alongside the usual statistical tests.[29] Figure 3.1 presents visually the time evolution of overall, residual and persistent cost efficiencies for the two bank types.

[Table 3.3 around here]

[Figure 3.1 around here]

Community banks exhibit superior cost efficiency over the full sample period by around 5% compared to the non-community banks. In addition, community banks have been consistently featuring higher cost efficiency across all years compared to the non-community banks. The cost efficiency estimates span from the low of 70.5% in 1986 to the high of 77.7% in 2005. For non-community banks the lowest cost efficiency estimate is observed in 2013 (69.2%), while the highest is in 2005 (73.8%). The spike of cost efficiency in the years prior to the global financial crisis may be linked to the rapid expansion of financial products and practices that, *a posteriori*, have been put under the microscope for aggravating the crisis (Martin-Oliver et al.,

[29] The estimated coefficients for the cost frontier are presented in table A3.3 in the appendix.

2013). A similar conclusion is reached in Alexakis et al. (2019) for a cross-country study, suggesting that the main driver for efficiency spikes observed before a financial crisis is the positive technology change reflective of the expansion in product availability; a fact that is less pronounced in the more traditional bank type of the sample. Qualitatively our results are in line with Feng and Zhang (2012) who find higher technical efficiency score for small and large community banks during the period 1997 to 2006.

Delving into the cost efficiency decompositions, we find the community banks to exhibit higher residual and persistent efficiency compared to the non-community banks. In particular and for the full sample, the managerial skills reflected in residual efficiency are higher in community banks by approximately 0.70%. The dynamics of residual efficiency provide interesting insights. In particular, the difference between the two bank types appears relatively constant in the period between the early 90s bank crisis and the global financial crisis, with the exception of the years immediately prior to the global financial crisis where the gap is diminished. The trade-off between risk and efficiency, where short-term reductions in credit checks and loan monitoring may materialise in an artificial rise in cost efficiency, referred to as cost "skimping" may be partially driving the surge in residual efficiency of non-community banks (Berger and DeYoung, 1997). A divergence in residual efficiency between the two bank types is observed after the global financial crisis as the community banks widen the gap to the non-community ones with the difference reaching to 1.80%.

The difference in persistent efficiency between the two bank types over the full sample finds the community banks on top by around 4.90%, which increases to over 5.10% in the years following the global financial crisis. The gradual rise of persistent efficiency for community banks over time may be traced to bank- specific developments in the sector. For example, the Federal Reserve have typically waved consolidated capital requirement for the majority of community banks (e.g., below $500 million), simplified capital standards and documentation for commercial real estate (CRE) loans, and delayed implementation of accounting rules changes (Bonilla et al., 2018). In recognising the catalytic role of community banks to the local economy, customised supervisory procedures are being developed, to strengthen the community banking institution.

Decomposing overall efficiency into its components allows us to test whether the higher overall cost efficiency score of community banks is economically significant. The 5% difference in the overall efficiency scores between the two groups in mostly driven by difference in the persistent efficiency rather than residual efficiency where the magnitude of the difference is very small (4.90% versus 0.70%). So, higher persistent efficiency is the source of better overall efficiency performance of community banks. This result is anticipated since it is related to institutional and regulatory factors that are tailored for community banks. Community banks benefit from a friendlier regulatory environment. Dodd-Frank regulations have been pushed back for community banks including the simplification of capital requirements. This regulatory relief has positive implications for their efficiency and eventually translates into higher overall efficiency for this bank group.

Table 3.4 presents average efficiency results for the two bank types per state. In terms of overall cost efficiency community banks in Iowa (IA), Minnesota (MN), North Dakota (ND) and Nebraska (NE) have the higher efficiency scores – close to 80%, whereas community banks in Hawaii (HI) the lowest (68.9%). This holds true for persistent efficiency as well. Iowa (IA), Minnesota (MN) and North Dakota (ND) are the states where both community and non-community banks have the highest overall and persistent efficiency scores. Non-community banks operate under the lowest efficiency in Delaware (DE) and South Dakota (SD); 62.9% and 62.4% respectively. Figure 3.2 depicts efficiency scores in maps for the two bank groups. Community banks with the highest overall and persistent efficiency scores are concentrated in the North and mid- North part. Non-community banks in the mid- West and South have the lowest overall efficiency scores whereas non-community banks located in the East have the highest residual efficiency.

[Table 3.4 around here]

[Figure 3.2 around here]

3.5.2 Determinants of cost efficiency

In this section we present the results of the second stage analysis on the determinants of efficiency. Table 3.5 presents estimated coefficients, robust standard errors and standard goodness-of-fit statistics of equation 3.6. Model I includes only bank-specific variables, model II includes both bank-specific, market structure and macroeconomic variables and intercept and slope CB dummies. Models I and II are repeated for community and non-community banks separately.

[Table 3.5 around here]

Of primary interest is the coefficient of the community bank binary variable. The results of all three models suggest that community banks are more cost efficient than non-community banks, as evident by the significant and positive coefficient of the community bank dummy. Based on models I and II community banks outperform their non-community counterparts. This result is in support of our earlier, unconditional findings. Our finding is in line with Elyasiani and Mehdian (1995) that compare the performance of very small US banks (less than $50 million in assets), mid-size and large banks (more than $400 million in assets) and find that small banks were more efficient than large banks.

The coefficient for bank size is significantly negative for the full sample and for the community and non- community sub samples, suggesting that large banks exhibit lower cost efficiency possibly due to diseconomies of scale, a finding in line with Kwan (2006). The interaction with the community bank dummy further suggests that the negative size effect on cost efficiency is more pronounced for the community banks. Smaller banks can be more efficient in exploit niche opportunities, in small business lending in particular, as they have a competitive advantage over the information opacity of these firms. McKee and Kagan (2018) claim that as community banks increase their asset base, efficiency drops as a result of the bank's incapability to translate elevated assets into loans. This finding is also in line with Berger et al. (2005) suggesting that small banks have an advantage in producing and using "soft" information in providing lending to SMEs. These can be businesses with high growth potential that depend on bank lending before going public and gain access to capital markets. Relatedly, Jacewitz and Kupiec (2012) suggest that the lending specialisation of community banks does not benefit from bank sizes in excess of $500 million; in part due to the exemption from the certain regulatory requirements these banks enjoy.

In terms of ownership structure, community banks that are part of bank holding companies exhibit lower cost efficiency; the opposite being true for non-community banks. For the non-community banks, higher cost efficiency may be related to the economies of scale and scope brought about by their participation in a bank holding company. However, as community banks may be pursuing goals other than profit maximisation, being part of a bank holding company may change their focus and dilute their distinct character; thus, affecting their performance. The community bank results are in line with Akhigbe and McNulty (2005) who suggest that small banks that are independent of bank holding company are more profit efficient.

A high deposit to assets ratio is negatively associated with cost efficiency, suggesting that the banks that fund their assets primarily via deposits tend to be less efficient. The effect has the same direction for both bank types, but is, on average across the two specifications, more pronounced for the community banks. Bank funding is typically done either via deposits and/or through securities and capital markets. Attracting funding via the latter is likely to be a competitive process on behalf of the bank, and inaccessible (or prohibitively costly) to the smallest of banks. By contrast, the small community banks are local in their operations, and often without tough competition with regards to deposit taking from the public. Hence community banks may not have to work as hard to attract deposits as non-community banks do, simply because they may be the only bank in the vicinity.[30]

In terms of profitability, a positive link is found between ROE and efficiency for community banks suggesting that more profitable community banks tend to be more efficient. On the other hand, the effect of profitability on efficiency is negative for the non-community banks. This may be explained by the moral hazard/agency problems that non-community banks may face and/or bad management (Berger and DeYoung, 1997). These banks in pursuit of higher profitability may reduce credit monitoring of investments (bad management) and/or engage in high risk projects (moral hazard); thus, increasing bank risk taking and negatively affecting efficiency. By contrast, the community banks' relationship lending approach may be particularly effective in reducing moral hazard.

Regarding the relationship between cost efficiency and liquidity creation, the results show that higher liquidity creation is associated with lower cost efficiency for the community banks, while the opposite is true for the non-community ones. While both measures may be considered as performance benchmarks, their focus is different. Financial institutions opt to maximise cost efficiency for several reasons, such as a response to increasing competition (Fiordelisi et al., 2011) or a softer regulatory touch (Altunbas et al., 2007) among others. By contrast, pursuing a strategy that maximises liquidity creation may not be as straightforward. By creating more liquidity for the economy, the bank makes itself more illiquid in the process and could be more vulnerable to non-performing loans or higher liquidity risk due to asset-liability duration gap. However, as community banks specialise in loan making operations for the local economies,

[30] The FDIC estimates that a significant part of the US population lives in underbanked environments, often only served by a few community banks.

liquidity creation may be a more suitable objective for them. For community banks the risk of having to "fire-sale" assets in order to meet liquidity shortages could be significant since they lack the sophisticated financial instruments and access to capital markets to do so. In addition, the inverse relationship between cost efficiency and liquidity creation for community banks may suggest that pursuing a liquidity creation maximisation strategy may not be aligned with maximising cost efficiency, possibly due to the highly human intensive loan making and credit checking mechanisms that community banks employ (Feng and Zhang, 2012; McKee and Kagan, 2018). Our results imply that regulation for community banks should take into account the liquidity creation besides cost efficiency. In particular, policies aimed to increase cost efficiency in financial institutions may be disadvantageous for community banks, as for these banks cost efficiency and liquidity creation are inversely related.

With respect to the different loan categories, agricultural, commercial real estate, and commercial and industrial loans have a significantly positive effect on cost efficiency for both bank types. Higher volumes of construction and development loans, and loans to individuals increases the cost efficiency of community banks only, possibly a reflection of the superiority of these banks in handling agency issues. Contrarily, higher volumes of residential mortgages translates into higher efficiency for non-community banks.

With respect to the environmental variables, inflation is positively linked to efficiency for community banks, while the opposite direction is observed for the non-community banks. The positive relation between inflation and efficiency for community banks is in line with findings documented elsewhere about concerns of these banks for periods of sustained low inflation (Bonilla et al., 2018). The impact economic uncertainty is also reflected in the positive and significant coefficient of the policy uncertainty index for community banks only. Taken together it suggests that the banking model of community banks renders them robust against economic uncertainty. The coefficient on the crisis binary variable shows a significant negative effect on the cost efficiency for community banks only.[31]

[31] The analysis is repeated for both components of efficiency i.e., residual and persistent and our results hold.

3.5.3 Robustness tests

We test the robustness of our results against developments in the regulatory/supervisory framework by splitting the sample into four distinct time periods, namely : i) Pre-1991, i.e., pre-Basel I and pre-FDIC Improvement Act; ii) between 1991 and 1999, i.e., pre-Financial Modernisation Act; iii) between 2000 and 2010, i.e., pre-Basel III and pre-Dodd-Frank Act; iv) post 2011, i.e., post Dodd-Frank Act. These results do not challenge the main findings of the paper and are provided in table A3.4i-iv in the appendix 3.1. We also test the robustness of our results by only including banks that have financial information across the full time span of our study (this leaves us with 2,226 community banks and 154 non-community banks). Our results confirm the main results of the paper, most notably the efficiency advantage of community banks, and are provided in table A3.5 in the appendix 3.1. We also use an alternative definition of community banks that relies solely on bank size. In particular, we use $2 billion in total assets as the size cut-off for community banks and we eliminate banks over $10 billion from the sample in line with (Chiorazzo et al., 2018). The results from this analysis remain qualitative the same and suggest that community banks are more efficient than their counterparts. However, when using this size-based definition, the magnitude of the effect of the community bank dummy on the efficiency score is approximately 3 times larger than when using the FDIC definition. Furthermore, using both community bank definitions (e.g., the FDIC one and the size-based one) shows that the efficiency advantage associated with the Community bank type comes both from size and business model attributes. These results are provided in the appendix 3.1, see Tables A3.6 and A3.7.

3.6 Further analysis

3.6.1 Size and stability sample splits

In this section model II is repeated with a sample split based on bank size and stability. These results are presented in table 3.6. The splits are based on the median values of total assets for size and the median value of z-score for stability. Median values are calculated for each group (i.e., all banks, community and non-community banks) separately for the full sample.[32]

[Table 3.6 around here]

Our primary interest focuses on the coefficient of the community bank dummy, which is significantly positive and supports the main results of the paper. In addition, the large community banks are significantly more efficient than the small community banks; the latter being arguably too small to reap any scale economies (DeYoung and Torna, 2013). However, the negative coefficient on assets for both groups of community banks suggests that the lending specialisation of these banks shows limited benefits through economies of scale. The financial stability split suggests that the superior efficiency profile of community banks is mainly driven by the least financially stable.

The effect of capitalisation on the efficiency of financial institutions is positive for the community banks, and of higher magnitude for small rather than large community banks. Likewise, the split by financial stability shows that community banks exhibit a positive relationship between capitalisation and efficiency. By contrast, for the non-community banks the relationship between capitalisation and efficiency changes with size. For the large non-community banks we find evidence of a negative relationship. Similarly, a particularly strong negative relationship between capitalisation and efficiency for the non-community banks in the low financial stability category is documented. This negative relationship may imply that banks with lower capital levels may be susceptible to a moral hazard behaviour, whereby bank managers are likely to take on risky projects when the capital is low (Berger and DeYoung, 1997). The bank management engages in riskier investments/practices in an attempt to artificially boost efficiency in the short-run; a practice referred to as cost skimping (Berger and DeYoung, 1997).

The impact of credit and liquidity risk on efficiency by bank type, size and/or financial stability provides interesting reading. By and large our results here confirm the main part of the paper, whereby both credit and liquidity risk have a negative impact on banking efficiency. The size splits shown here suggest that the efficiency of the small community banks is the least affected

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[32] The median values for the size splits are: 68,209 (All banks); 60,688 (CBs); 255,644 (non-CBs). The median values for the risk splits are: 20.768 (All banks); 21.040 (CBs); 19.096 (non-CBs).

by variations in either credit or liquidity risk. Further, the risk splits suggest minimal variation in the marginal effects for the community banks between the high/low financial risk groups. This plausibly suggests a homogenous risk profile of the community banks. By contrast, the marginal effects corresponding to the high/low risk group of the non-community banks show high variation, possibly driven from the wider disparity of these banks in terms of products, clientele and practices.

The relation between efficiency and liquidity creation is largely negative as in the main results of the paper, however the magnitude becomes stronger in small and community banks. This corroborates the main policy implications around the need for the liquidity creation and the efficiency to be viewed complementary performance measures for community banks.

3.6.2 Comparison with a basic cost efficiency analysis

In this section we employ the maximum likelihood approach to estimate a basic cost frontier model following Kumbhakar et al. (2015).[33] The average overall efficiency score for community banks over the whole sample period is 77.8%, ranging from 71.9% during 2013 to 79.9% in 1994. Community banks are about 3% more efficient. However, this particular cost efficiency analysis would incorrectly classify the efficiency benefit of community banks as solely coming from their managerial superiority. For non-community banks it is 74.9%, ranging from 66.4% in 2013 to 78.0% in 1994. Again, we notice that community banks in Iowa (IA) operate under the higher efficiency scores (83.2%) and non-community banks operating in South Dakota (SD) have the lowest average scores (60.9%). We repeat the second stage regressions using as dependent variable the efficiency scores derived from the model specified before and the results are consistent with the main part of the paper. In particular, community banks have around 1.2% higher efficiency scores, *ceteris paribus*. The coefficients for the rest of the variables of interest remain the same.[34]

[Table 3.7 around here]

[Table 3.8 around here]

[33] More details on how we calculate the cost frontier are given in Appendix 3.2.
[34] The tables 3.7, 3.8 and 3.9 report efficiency scores by year, by state and bank type as well as the second-stage regression results.

[Table 3.9 around here]

3.6.3 Matching analysis of community and non-community banks

In our main analysis we have assumed level and slope differences between the two bank types. However, this technique leads to a large number of parameters to estimate. An alternative approach would be to utilise matching techniques, such as the k-means nearest neighbour matching and the propensity score matching. We refer to "matching" broadly as any method that equates the distribution of covariates in the treated and control groups. The k-means nearest neighbour matching is a non-linear, non-parametric technique that clusters together banks with similar financial characteristics. The advantage of this technique is that it does not rely on a formal model, like propensity score, thus it is more flexible. Instead, the k-means relies on some distance function.[35]

We match community and non-community banks on the following bank-specific characteristics: the natural logarithm of asset size, deposit to asset ratio, credit risk proxy, loan loss allowance to total loans, equity to assets, liquidity risk proxy, return on equity, natural logarithm of the z-score, cost to income ratio, liquidity creation and whether they are part of bank holding company. The coefficient is 0.024 and significant at 1% level, suggesting that community banks are around 2.4% more efficient. We get the same result (coefficient is 0.022 significant at 1%) when we include in the matching process bank- specific, macroeconomic and economic environment variables (e.g., GDP, inflation, crisis dummy and the political uncertainty index).[36]

3.7 Conclusion

Community banks do business in ways that are different from non-community banks. They specialize in relationship banking, are the main source of credit to small and medium size businesses, and play a prominent role in their local economies. Despite the consolidation in the

[35] Appendix 3.2 gives more details on this approach.

[36] We also do propensity score matching and get a significant positive coefficient of 0.024, which verifies that community banks have higher overall efficiency than their non-community counterparts.

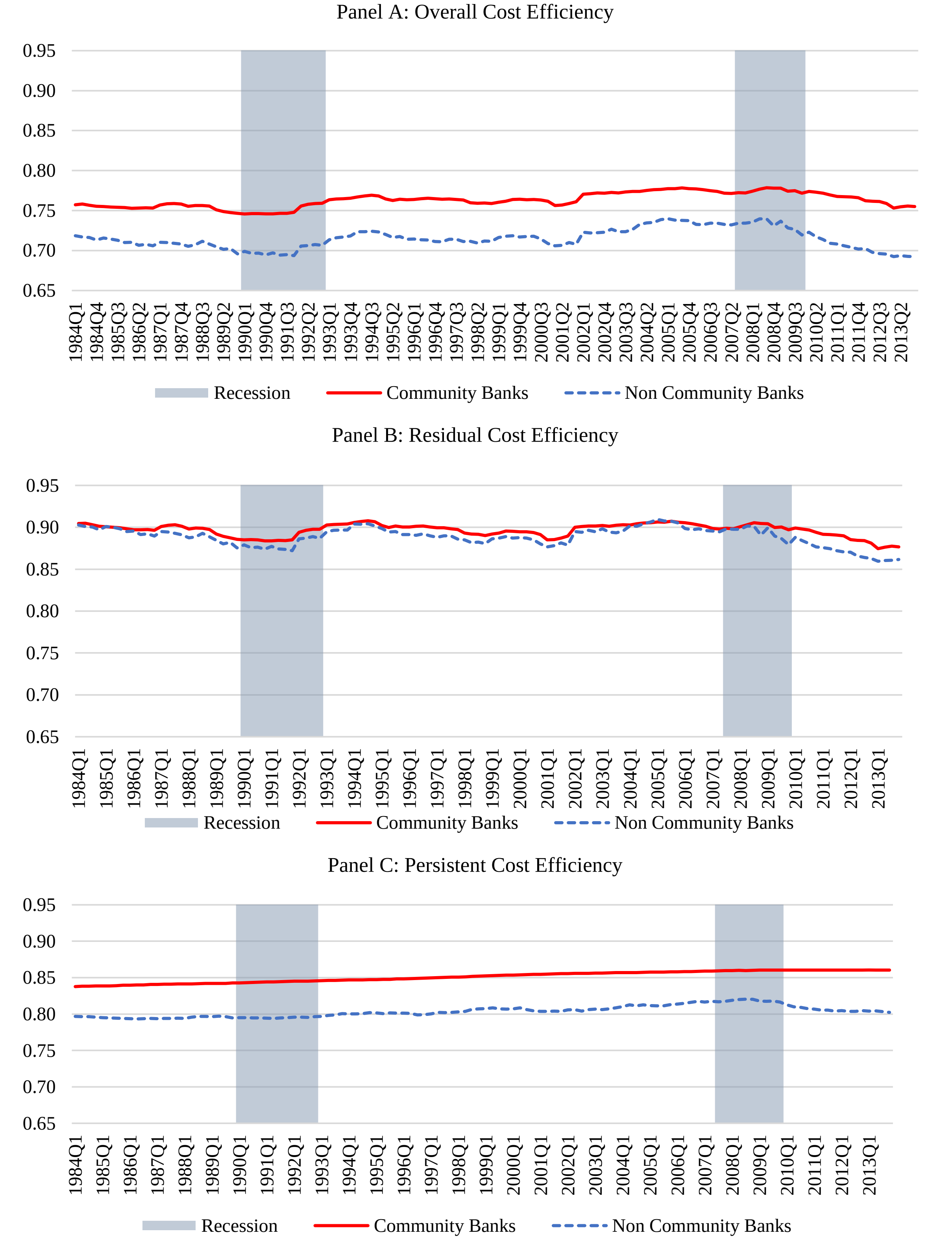
US banking sector, community banks are still a key part of the US financial system and seem to retain their unique characteristics against non-community banks.

In this chapter we examine the efficiency dynamics between the two bank types over a long time period, spanning over thirty years and two periods of economic turmoil. Previous research in community banks has used a single criterion to define them, namely asset-size. We innovate by using the novel FDIC definition that separates community banks via a comprehensive range of financial and business type screening criteria; thus allowing us to separate any effect from the "relationship banking" approach that community banks prescribe to from pure size effects. For the cost efficiency estimation we rely on the Kumbhakar et al. (2014) model, which we tailor to our research requirements, as it allows the decomposition of cost efficiency into a residual and a persistent component that captures managerial deficiencies and market structure/regulatory rigidities respectively. In a second stage, we compare and contrast the determinants of cost efficiency across the two bank types, across a wide array of explanatory variables capturing bank-specific, macroeconomic and market structure characteristics.

Our findings reveal that community banks exhibit superior cost efficiency than their non-community counterparts, consistently across the years of the study. The managerial skills reflected in residual efficiency are higher in community banks, with the gap to non-community banks closing prior to periods of crisis. The largest part of the cost efficiency gap between the two bank types stems from differences in persistent efficiency that may be traced to bank-specific developments in the sector, such as the Fed imposing less stringent capital and regulatory requirements for community banks.

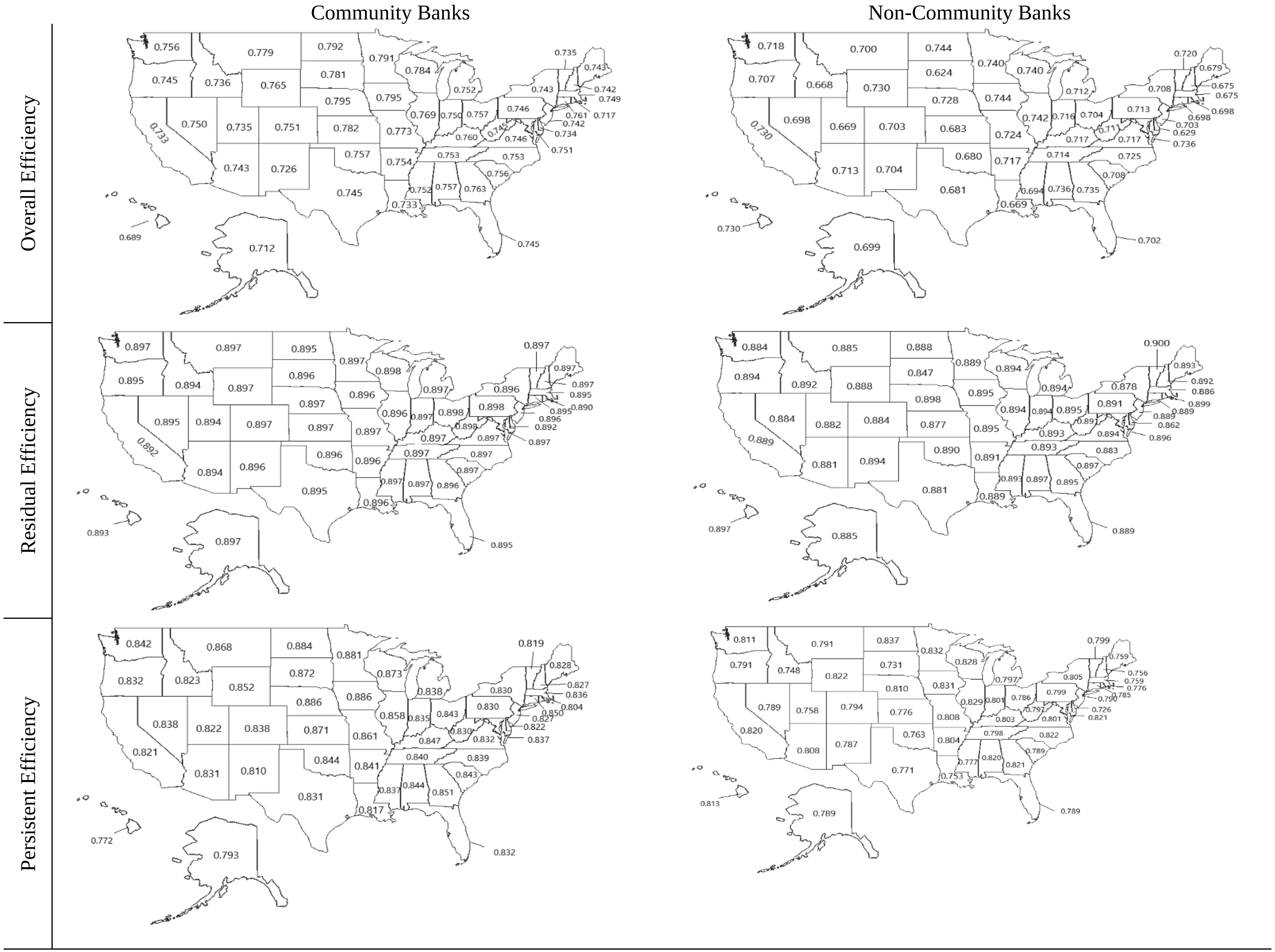
With regards to key determinants of efficiency we find a negative link between bank size and cost efficiency, with the magnitude being stronger for community banks suggesting that these banks perform better when they are small in size. A related finding is that community banks that are part of a bank holding company have significantly lower cost efficiency scores, possibly due to differences in objectives and goals that exist between community and non-community banks, most notably as community banks do not solely focus on profit maximisation. Higher liquidity creation translates into lower cost efficiency for community banks but higher for non-community. Financial institutions may maximise cost efficiency for reasons related to combat increasing competition, capitalisation requirements and performance. Maximising liquidity creation may be more desirable for community banks as they engage more into loan making activities to the real economy. An implication of our results is that any regulation should take into account the liquidity creation measure besides cost efficiency, particularly for community banks. With respect to the macroeconomic environment, inflation has a significant effect only for community banks.

Figure 3.1: Cost efficiency scores across time.



NOTES: Figure reports the mean efficiency scores for overall (Panel A), residual (Panel B) and persisitent (Panel C) cost efficiency scores acrosss time. Recession marks the credit crunch (1990Q1-1992Q4) and the subprime lending crisis (2007Q3-2009Q4) following Berger and Bowman (2013). The average overall cost efficiency score is 75.5% for the full sample, 76.2% for community banks and 71.2% for non-community banks. The average residual efficiency score is 89.5% for the full sample, 89.6% for community banks and 88.9% for non-community banks. The average persistent efficiency score is 84.3% for the full sample, 84.9% for community banks and 80.0% for non-community banks.

Figure 3.2: Efficiency scores by state.



NOTES: Maps show average efficiency scores for the two bank groups per state for overall, residual and persisitent efficiency.

Table 3.1: Summary statistics for cost, outputs and input prices.

Variable	Obs	Mean	Median	SD	Min	Max
Panel A: All Banks						
Total Cost	1,031,306	30,963.08	3,566.018	529975.2	-139,916.6	71,300,000
Loans (y1)	1,031,307	499,927.9	54,945.65	8,442,200	1.324	752,000,000
Securities (y2)	1,031,307	157,079.6	23,883.69	2,953,581	0.009	353,000,000
Price of Labour (p1)	1,212,015	24.050	19.9	21.322	-368	11018
Price of Capital (p2)	1,207,086	0.303	0.157	9.887	-54	9810
Price of Funds (p3)	1,213,125	0.090	0.020	6.967	0	4068.5
Panel B: Community Banks						
Total Cost	900,648	6,238.632	3,157.566	11,850.29	-37.959	1,072,341
Loans (y1)	900,649	102,387.9	48,658.16	193,514	23.694	12,900,000
Securities (y2)	900,649	41,926.14	21,721.29	85,919.53	0.009	7,244,442
Price of Labour (p1)	1,066,012	23.892	20	19.745	-42	11018
Price of Capital (p2)	1,062,390	0.269	0.156	1.295	-2	520
Price of Funds (p3)	1,066,649	0.025	0.020	0.340	0	182.111
Panel C: Non-Community Banks						
Total Cost	130,578	201,485.6***	13,347.55***	1,477,860***	-139,916.6	71,300,000
Loans (y1)	130,578	3,241,974***	204,084.8***	23,500,000***	1.324	752,000,000
Securities (y2)	130,578	951,335***	66,515.14***	8,253,881***	0.009	353,000,000
Price of Labour (p1)	145,850	25.212***	19.436***	30.443***	-368	4141.5
Price of Capital (p2)	144,543	0.559***	0.169***	28.354***	-54	9810
Price of Funds (p3)	146,322	0.563***	0.025***	20.034***	0	4068.5

NOTES: The table presents summary statistics for Total Cost, Outputs and Inputs used in the efficiency estimation for all banks (Panel A), Community banks (Panel B) and Non-Community banks (Panel C). The price of labour is calculated as salaries and employee benefits over the number of full- time equivalent employees, the price of capital calculated as expenses on premises and fixed assets over premises and fixed assets and the price of funds calculated as total interest expenses over total deposits. Monetary amounts have been deflated using the GDP deflator and are expressed in thousands USD. *** denotes statistical significance at the 1% level.

Table 3.2: Descriptive statistics for the variables used in the second stage analysis.

Variable	Obs	Mean	Median	SD	Min	Max
Panel A: All banks						
Total Assets (ln)	1,213,125	11.273	11.119	1.386	4.727	21.411
Deposits/Assets	1,213,125	0.853	0.876	0.091	0.000	1.686
Credit Risk	1,207,785	0.249	0.051	8.226	-143	6658
Loan Loss Allowance/Gross Loans	1,213,125	0.016	0.013	0.017	-0.104	8
Equity/Assets	1,213,125	0.101	0.090	0.054	0.010	0.999
Liquidity Risk	1,213,125	0.368	0.304	4.497	-1.528	1,304.750
ROE	1,213,125	0.037	0.055	0.737	-53.534	394.019
z-score (ln)	1,206,664	2.896	3.031	0.672	-6.875	6.768
Cost/Income	1,207,006	0.838	0.808	1.595	-143.909	1,470
Liquidity creation	1,031,307	0.221	0.213	0.477	-0.948	230.036
Construction & Development Loans	1,213,125	0.031	0.213	0.053	0	0.843
Agricultural Loans	1,213,125	0.051	0.008	0.085	0	0.790
Commercial Real Estate Loans	1,213,125	0.331	0.310	0.182	0	1.009
Commercial & Industrial Loans	1,213,125	0.072	0.048	0.086	0	1.891
Residential Mortgages	1,213,125	0.163	0.135	0.128	0	1.145
Loans to Individuals	1,213,125	0.085	0.063	0.089	0	1.204
Panel B: Community Banks						
Total Assets (ln)	1,066,649	11.072	10.9998	1.155	5.649	16.924
Deposits/Assets	1,066,649	0.861	0.878	0.068	0.000	1.686
Credit Risk	1,055,983	0.235	0.046	4.746	-143	2863
Loan Loss Allowance/Gross Loans	1,066,649	0.016	0.013	0.013	-0.104	4.545
Equity/Assets	1,066,649	0.102	0.092	0.049	0.010	0.999
Liquidity Risk	1,066,649	0.295	0.300	0.245	-0.986	54.021
ROE	1,066,649	0.035	0.054	0.771	-53.534	394.019
z-score (ln)	1,060,940	2.914	3.047	0.665	-6.875	6.263
Cost/Income	1,060,850	0.842	0.809	1.663	-143.909	1,470
Liquidity creation	900,649	0.207	0.204	0.180	-0.948	3.477
Construction & Development Loans	1,066,649	0.031	0.010	0.053	0	0.843
Agricultural Loans	1,066,649	0.056	0.012	0.089	0	0.738
Commercial Real Estate Loans	1,066,649	0.333	0.312	0.180	0	0.989
Commercial & Industrial Loans	1,066,649	0.069	0.045	0.084	0	1.891
Residential Mortgages	1,066,649	0.164	0.136	0.127	0	1.145
Loans to Individuals	1,066,649	0.079	0.061	0.069	0	1.158
Panel C: Non-Community Banks						
Total Assets (ln)	146,322	12.746***	12.411***	1.933***	4.727	21.411
Deposits/Assets	146,322	0.795***	0.852***	0.174***	0	1.429
Credit Risk	143,900	0.366**	0.096***	20.067***	-63	6658.000
Loan Loss Allowance/Gross Loans	146,322	0.019***	0.014***	0.036***	0	8
Equity/Assets	146,322	0.097***	0.078***	0.080***	0.010	0.998
Liquidity Risk	146,322	0.900***	0.340***	12.918***	-1.528	1,304.750
ROE	146,322	0.051***	0.063***	0.399***	-37.572	12.830
z-score (ln)	145,579	2.768***	2.928***	0.712***	-5.366	6.768
Cost/Income	146,007	0.815***	0.799***	0.958***	-116.921	276
Liquidity creation	130,578	0.319***	0.278***	1.251***	-0.888	230.036
Construction & Development Loans	146,322	0.036***	0.016***	0.054***	0	0.702
Agricultural Loans	146,322	0.014***	0***	0.037***	0	0.790
Commercial Real Estate Loans	146,322	0.317***	0.295***	0.194***	0	1.009
Commercial & Industrial Loans	146,322	0.095***	0.075***	0.099***	0	1.007
Residential Mortgages	146,322	0.156***	0.130	0.133***	0	1.008
Loans to Individuals	146,322	0.131***	0.086***	0.169***	0	1.204

NOTES: The table shows the summary statistics for the bank- specific variables used in the second stage analysis. Data are retrieved from Call reports. Z-score is calculated following Cihak and Hesse (2007). Statistics are based on quarterly data from 1984 to 2013. Sample consists of 20,099 banks. Panel A contains all banks in the sample, panel B contains only community banks and panel C only non-community. Assets and z-score are expressed in logarithms. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. Liquidity creation is measured by the CatFat to Gross Total Assets, following Berger and Bowman (2009). All loan categories are expressed as a ratio to total assets. *** and ** denote statistical significance at the 1% and 5% level respectively.

Table 3.3: Efficiency measures per year and bank type

	Overall Efficiency		Residual Efficiency		Persistent Efficiency	
	Community Banks	Non-Community Banks	Community Banks	Non-Community Banks	Community Banks	Non-Community Banks
1984	0.756	0.716***	0.903	0.900***	0.838	0.796***
1985	0.754	0.713***	0.899	0.898**	0.838	0.794***
1986	0.705	0.707***	0.896	0.892***	0.839	0.793***
1987	0.758	0.709***	0.901	0.893***	0.840	0.793***
1988	0.755	0.708***	0.898	0.889***	0.841	0.795***
1989	0.748	0.701***	0.888	0.880***	0.842	0.796***
1990	0.746	0.696***	0.884	0.876***	0.843	0.794***
1991	0.746	0.695***	0.884	0.874***	0.844	0.794***
1992	0.757	0.706***	0.896	0.887***	0.845	0.795***
1993	0.764	0.716***	0.903	0.896***	0.846	0.798***
1994	0.768	0.723***	0.906	0.903***	0.847	0.800***
1995	0.763	0.717***	0.900	0.894***	0.847	0.801***
1996	0.764	0.713***	0.900	0.890***	0.848	0.800***
1997	0.763	0.712***	0.898	0.888***	0.850	0.801***
1998	0.759	0.711***	0.891	0.882***	0.851	0.805***
1999	0.762	0.717***	0.893	0.887***	0.852	0.807***
2000	0.763	0.714***	0.893	0.885***	0.853	0.806***
2001	0.758	0.707***	0.886	0.878***	0.855	0.803***
2002	0.771	0.722***	0.901	0.894***	0.855	0.805***
2003	0.772	0.724***	0.902	0.895***	0.856	0.807***
2004	0.775	0.735***	0.904	0.903	0.857	0.811***
2005	0.777	0.738***	0.906	0.907	0.857	0.811***
2006	0.775	0.733***	0.903	0.897***	0.858	0.815***
2007	0.771	0.733***	0.898	0.896**	0.859	0.817***
2008	0.776	0.736***	0.903	0.897***	0.859	0.819 ***
2009	0.774	0.728***	0.900	0.888***	0.860	0.817***
2010	0.772	0.716***	0.897	0.882***	0.860	0.809***
2011	0.767	0.704***	0.890	0.873***	0.860	0.805***
2012	0.761	0.697***	0.883	0.865***	0.860	0.804***
2013	0.754	0.692***	0.876	0.860***	0.860	0.803***
Total	**0.762**	**0.712*****	**0.896**	**0.889*****	**0.849**	**0.800*****

NOTES: Table reports mean values and t tests for overall, residual and persistent efficiency for the two bank types. Mean values are reported by year. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table 3.4: Efficiency measures per state and bank type

	Overall Efficiency		Residual Efficiency		Persistent Efficiency	
	Community Banks	Non-Community Banks	Community Banks	Non-Community Banks	Community Banks	Non-Community Banks
AK	0.712	0.699***	0.897	0.885***	0.793	0.789
AL	0.757	0.736***	0.897	0.897	0.844	0.820***
AR	0.754	0.717***	0.896	0.891***	0.841	0.804***
AZ	0.743	0.713***	0.894	0.881***	0.831	0.808***
CA	0.733	0.730***	0.892	0.889***	0.821	0.820*
CO	0.751	0.703***	0.897	0.884***	0.838	0.794***
CT	0.761	0.698***	0.895	0.889***	0.850	0.785***
DE	0.734	0.629***	0.892	0.862***	0.822	0.726***
FL	0.745	0.702***	0.895	0.889***	0.832	0.789***
GA	0.763	0.735***	0.896	0.895***	0.851	0.821***
HI	0.689	0.730***	0.893	0.897	0.772	0.813***
IA	0.795	0.744***	0.896	0.895*	0.886	0.831***
ID	0.736	0.668***	0.894	0.892	0.823	0.748***
IL	0.769	0.742***	0.896	0.894***	0.858	0.829***
IN	0.750	0.716***	0.897	0.894***	0.835	0.801***
KS	0.782	0.683***	0.897	0.877***	0.871	0.776***
KY	0.760	0.717***	0.897	0.893***	0.847	0.803***
LA	0.733	0.669***	0.896	0.889***	0.817	0.753***
MA	0.749	0.675***	0.895	0.886***	0.836	0.759***
MD	0.751	0.736***	0.897	0.896	0.837	0.821***
ME	0.743	0.679***	0.897	0.893**	0.828	0.759***
MI	0.752	0.712***	0.897	0.894***	0.838	0.797***
MN	0.791	0.740***	0.897	0.889***	0.881	0.832***
MO	0.773	0.724***	0.897	0.895***	0.861	0.808***
MS	0.752	0.694***	0.897	0.893***	0.837	0.777***
MT	0.779	0.700***	0.897	0.885***	0.868	0.791***
NC	0.753	0.725***	0.897	0.883***	0.839	0.822***
ND	0.792	0.744***	0.895	0.888***	0.884	0.837***
NE	0.795	0.728***	0.897	0.898	0.886	0.810***
NH	0.742	0.675***	0.897	0.892**	0.827	0.756***
NJ	0.742	0.703***	0.896	0.889***	0.827	0.790***
NM	0.726	0.704***	0.896	0.894**	0.810	0.787***
NV	0.750	0.698***	0.895	0.884***	0.838	0.789***
NY	0.743	0.708***	0.896	0.878***	0.830	0.805***
OH	0.757	0.704***	0.898	0.895***	0.843	0.786***
OK	0.757	0.680***	0.896	0.890***	0.844	0.763***
OR	0.745	0.707***	0.895	0.894	0.832	0.791***
PA	0.746	0.713***	0.898	0.891***	0.830	0.799***
RI	0.717	0.698**	0.890	0.899*	0.804	0.776***
SC	0.756	0.708***	0.897	0.897	0.843	0.789***
SD	0.781	0.624***	0.896	0.847***	0.872	0.731***
TN	0.753	0.714***	0.897	0.893***	0.840	0.798***
TX	0.745	0.681***	0.895	0.881***	0.831	0.771***
UT	0.735	0.669***	0.894	0.882***	0.822	0.758***
VA	0.746	0.717***	0.897	0.894***	0.832	0.801***
VT	0.735	0.720***	0.897	0.900	0.819	0.799***
WA	0.756	0.718***	0.897	0.884***	0.842	0.811***
WI	0.784	0.740***	0.898	0.894***	0.873	0.828***
WV	0.745	0.711***	0.898	0.891***	0.830	0.797***
WY	0.765	0.730***	0.897	0.888***	0.852	0.822***

NOTES: Table reports mean values and t tests for overall, residual and persistent efficiency for the two bank types. Mean values are reported by state. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table 3.5: Second-stage regression results (dependent variable: Overall Efficiency score)

	All banks		Community banks		Non-Community banks	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.187***	0.193***				
	(0.019)	(0.023)				
Total Assets (ln)	-0.011***	-0.011***	-0.029***	-0.029***	-0.011***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.111***	-0.111***	-0.113***	-0.109***	-0.117***	-0.119***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Credit risk	-0.005***	-0.005***	-0.005***	-0.005***	-0.007***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan Loss Allowance / Loans	-0.428***	-0.331***	-0.260***	-0.223***	-0.317***	-0.248***
	(0.027)	(0.027)	(0.012)	(0.016)	(0.027)	(0.026)
Equity / Assets	-0.082***	-0.079***	0.032***	0.034***	-0.053***	-0.065***
	(0.011)	(0.011)	(0.003)	(0.004)	(0.012)	(0.011)
Liquidity risk	-0.004***	-0.007***	-0.021***	-0.021***	-0.008***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ROE	-0.023***	-0.020***	0.050***	0.047***	-0.027***	-0.024***
	(0.005)	(0.006)	(0.009)	(0.011)	(0.006)	(0.007)
z-score (ln)	0.003***	0.003***	0.001	0.001	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cost / Income	-0.095***	-0.092***	-0.024*	-0.024	-0.109***	-0.104***
	(0.007)	(0.008)	(0.013)	(0.015)	(0.009)	(0.009)
Bank Holding Company	0.009***	0.008***	-0.004***	-0.003***	0.013***	0.013***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Liquidity Creation	0.024***	0.025***	-0.031***	-0.028***	0.040***	0.038***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Construction & Development Loans	-0.002	-0.012**	0.011***	0.015***	-0.028***	-0.026***
	(0.005)	(0.005)	(0.001)	(0.001)	(0.005)	(0.005)
Agricultural Loans	0.238***	0.237***	0.155***	0.150***	0.254***	0.261***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Commercial Real Estate Loans	0.047***	0.054***	0.090***	0.085***	0.052***	0.056***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Commercial & Industrial Loans	0.145***	0.143***	0.093***	0.089***	0.098***	0.105***
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Residential Mortgages Loans	0.040***	0.036***	-0.048***	-0.041***	0.045***	0.042***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Loans to Individuals	-0.036***	-0.038***	0.003	-0.001	-0.042***	-0.040***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Crisis		-0.001***		-0.001**		-0.001
		(0.001)		(0.001)		(0.003)
Policy Uncertainty Index (ln)		0.001***		0.002***		-0.001
		(0.001)		(0.001)		(0.001)
Real GDP Growth		-0.020**		0.002		-0.034***
		(0.008)		(0.006)		(0.011)
Inflation		0.080***		0.019		-0.110***
		(0.030)		(0.024)		(0.032)
Total Assets (ln) × CB	-0.018***	-0.018***				
	(0.001)	(0.001)				
Deposit / Assets × CB	-0.004	-0.001				
	(0.003)	(0.003)				
Credit risk × CB	-0.001	0.001				
	(0.001)	(0.001)				
Loan Loss Allowance / Loans × CB	0.185***	0.121***				

	(0.031)	(0.032)				
Equity / Assets × CB	0.117***	0.113***				
	(0.011)	(0.012)				
Liquidity risk × CB	-0.018***	-0.015***				
	(0.001)	(0.001)				
ROE × CB	0.073***	0.066***				
	(0.011)	(0.012)				
z-score (ln) × CB	-0.002***	-0.002***				
	(0.001)	(0.001)				
Cost / Income × CB	0.071***	0.067***				
	(0.014)	(0.016)				
Bank Holding Company × CB	-0.013***	-0.011***				
	(0.002)	(0.002)				
Liquidity Creation × CB	-0.053***	-0.051***				
	(0.003)	(0.003)				
Real GDP Growth × CB		0.019*				
		(0.010)				
Inflation × CB		-0.087***				
		(0.019)				
Construction & Development Loans × CB	0.010**	0.024***				
	(0.005)	(0.005)				
Agricultural Loans × CB	-0.082***	-0.085***				
	(0.006)	(0.007)				
Commercial Real Estate Loans × CB	0.042***	0.032***				
	(0.003)	(0.004)				
Commercial & Industrial Loans × CB	-0.056***	-0.057***				
	(0.003)	(0.004)				
Residential Mortgages Loans × CB	-0.085***	-0.075***				
	(0.003)	(0.003)				
Loans to Individuals × CB	0.035***	0.035***				
	(0.003)	(0.003)				
Constant	0.975***	0.963***	1.156***	1.146***	1.022***	1.032***
	(0.010)	(0.010)	(0.018)	(0.024)	(0.011)	(0.015)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.2182	0.2256	0.2106	0.2181	0.1332	0.1380
Log Pseudolikelihood	1,773,706	1,657,477	1,619,898	1,514,545	175,533	165,184
Observations	947,291	870,599	835,878	766,872	111,413	103,727

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank-specific variables and Model II includes both bank- specific and macroeconomic variables. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table 3.6: Asset size and financial stability splits (dependent variable: Overall Efficiency score)

	All banks				Community banks				Non-Community banks			
	Small size	Large size	Low stability	High stability	Small size	Large size	Low stability	High stability	Small size	Large size	Low stability	High stability
Community Bank	0.008	0.195***	0.178***	0.276***								
	(0.024)	(0.019)	(0.018)	(0.018)								
Total Assets (ln)	-0.035***	-0.007**	-0.010***	-0.014***	-0.031***	-0.026***	-0.027***	-0.033***	-0.036***	-0.007***	-0.011***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.036***	-0.109***	-0.106***	-0.118***	-0.084***	-0.112***	-0.117***	-0.109***	-0.027***	-0.114***	-0.114***	-0.125***
	(0.010)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)	(0.001)	(0.009)	(0.003)	(0.004)	(0.005)
Credit risk	-0.006***	-0.006***	-0.007***	-0.001	-0.003***	-0.010***	-0.005***	-0.004***	-0.005***	-0.007***	-0.009***	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan Loss Allowance / Loans	-0.297***	-0.385***	-0.318***	-0.263***	-0.231***	-0.369***	-0.259***	-0.247***	-0.235***	-0.306***	-0.234***	-0.134**
	(0.040)	(0.029)	(0.028)	(0.060)	(0.010)	(0.013)	(0.012)	(0.008)	(0.043)	(0.029)	(0.028)	(0.058)
Equity / Assets	0.088***	-0.137***	-0.161***	-0.025	0.035***	0.120***	0.036***	0.037***	0.075***	-0.132***	-0.164***	-0.011
	(0.020)	(0.014)	(0.017)	(0.018)	(0.005)	(0.009)	(0.008)	(0.003)	(0.019)	(0.013)	(0.018)	(0.018)
Liquidity risk	-0.011***	-0.009***	-0.007***	-0.012***	-0.016***	-0.026***	-0.025***	-0.021***	-0.007**	-0.012***	-0.007***	-0.018***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)
ROE	0.017*	-0.025***	-0.024***	0.008	0.017***	0.058***	0.044***	0.033***	0.017*	-0.033***	-0.030***	-0.009
	(0.010)	(0.008)	(0.005)	(0.013)	(0.004)	(0.008)	(0.008)	(0.002)	(0.009)	(0.009)	(0.006)	(0.016)
z-score (ln)	0.005***	0.0018***	0.003***	0.005***	0.004***	-0.005***	0.001**	-0.001	0.005***	0.002***	0.0032***	0.005***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Cost / Income	-0.0873***	-0.113***	-0.101***	-0.074***	-0.053***	-0.013	-0.016	-0.085***	-0.083***	-0.124***	-0.111***	-0.085***
	(0.012)	(0.011)	(0.007)	(0.016)	(0.006)	(0.011)	(0.011)	(0.002)	(0.012)	(0.013)	(0.009)	(0.021)
Bank Holding Company	0.009**	0.0075***	0.003	0.014***	-0.002***	-0.005***	-0.003***	-0.002***	0.005	0.010***	0.005*	0.016***
	(0.004)	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.002)	(0.003)	(0.003)
Liquidity Creation	-0.025***	0.026***	0.033***	0.026***	-0.052***	-0.007***	-0.017***	-0.027***	-0.033***	0.040***	0.040***	0.040***
	(0.006)	(0.003)	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.007)	(0.003)	(0.004)	(0.004)
Construction & Development	-0.004	-0.016***	-0.023***	-0.035***	-0.002	0.007***	0.007***	0.004*	0.004	-0.032***	-0.033***	-0.060***
	(0.012)	(0.005)	(0.006)	(0.008)	(0.002)	(0.001)	(0.002)	(0.002)	(0.013)	(0.005)	(0.006)	(0.009)
Agricultural Loans	0.208***	0.194***	0.250***	0.224***	0.159***	0.131***	0.134***	0.147***	0.196***	0.234***	0.269***	0.232***
	(0.008)	(0.005)	(0.006)	(0.006)	(0.003)	(0.003)	(0.004)	(0.001)	(0.010)	(0.007)	(0.008)	(0.007)
Commercial Real Estate Loans	0.120***	0.071***	0.069***	0.034***	0.104***	0.073***	0.076***	0.085***	0.121***	0.072***	0.071***	0.037***
	(0.007)	(0.003)	(0.004)	(0.005)	(0.001)	(0.001)	(0.002)	(0.001)	(0.008)	(0.004)	(0.005)	(0.005)
Commercial & Industrial Loans	0.120***	0.155***	0.155***	0.106***	0.110***	0.097***	0.077***	0.104***	0.139***	0.120***	0.129***	0.072***
	(0.007)	(0.004)	(0.004)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.004)	(0.005)	(0.006)
Residential Mortgages Loans	-0.011*	0.027***	0.0270***	0.052***	-0.044***	-0.030***	-0.045***	-0.029***	-0.015**	0.031***	0.033*	0.056***

	(0.006)	(0.003)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)	(0.007)	(0.003)	(0.004)	(0.005)
Loans to Individuals	0.005	-0.026***	-0.038***	-0.021***	0.018***	-0.016***	-0.011***	0.010***	0.007	-0.031***	-0.036***	-0.020***
	(0.006)	(0.003)	(0.003)	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)	(0.006)	(0.003)	(0.004)	(0.004)
Crisis	-0.001	-0.002***	-0.001	-0.001*	-0.001	-0.001***	-0.001	-0.001**	-0.035	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.025)	(0.002)	(0.003)	(0.003)
Policy Uncertainty Index (ln)	0.001	0.003***	0.002***	0.001**	0.001	0.002***	0.001***	0.001***	-0.004	-0.001	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Real GDP Growth	-0.001	-0.001***	-0.001**	0.001**	-0.001***	0.001	0.001	-0.001*	-0.001**	-0.001***	-0.001***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Inflation	-0.001	-0.001	-0.001	0.002***	-0.001***	0.001	0.001	-0.001	-0.001	-0.002***	-0.002***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	1.155***	0.696***	0.729***	0.970***	1.162***	0.869***	0.893***	1.235***	1.165***	0.981***	1.021***	1.030***
	(0.022)	(0.013)	(0.010)	(0.018)	(0.010)	(0.017)	(0.017)	(0.004)	(0.030)	(0.018)	(0.017)	(0.026)
State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Community bank interactions	YES	YES	YES	YES	—	—	—	—	—	—	—	—
Pseudo R2	0.1940	0.1744	0.1916	0.2925	0.1900	0.1681	0.1764	0.2947	0.2054	0.1437	0.1539	0.1404
Log Pseudolikelihood	913,606	875,334	834,106	944,537	827,252	720,034	714,237	836,396	31,059	143,876	91,590	80,255
Observations	435,451	473,739	457,226	451,967	393,673	374,157	378,572	389,261	16,154	88,450	59,272	45,332

NOTES: The table presents second-stage regression results for the overall efficiency score. For the variant related to All banks, community bank interactions are included in the estimation (like in Table 5) but are not reported for brevity. Each model is estimated separately for small and large banks with the cut-offs determined by the median total assets of each bank type. The financial stability split is done on the basis of the median value of the z-score for each bank type. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table 3.7: Efficiency measures per year and bank type using the basic cost efficiency model

	Community Banks	Non-Community Banks
1984	0.796	0.774
1985	0.789	0.768
1986	0.786	0.756
1987	0.794	0.758
1988	0.783	0.749
1989	0.761	0.727
1990	0.753	0.719
1991	0.753	0.717
1992	0.778	0.747
1993	0.793	0.768
1994	0.799	0.780
1995	0.785	0.759
1996	0.784	0.751
1997	0.780	0.746
1998	0.769	0.740
1999	0.774	0.748
2000	0.773	0.738
2001	0.763	0.724
2002	0.788	0.755
2003	0.788	0.758
2004	0.789	0.769
2005	0.793	0.774
2006	0.789	0.763
2007	0.782	0.762
2008	0.790	0.769
2009	0.783	0.751
2010	0.773	0.725
2011	0.758	0.702
2012	0.738	0.681
2013	0.719	0.664
Total	**0.778**	**0.749**

NOTES: Table reports mean values and t tests for efficiency scores calculated using the basic cost frontier model for the two bank types. Mean values are reported by year. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively

Table 3.8: Efficiency measures per state and bank type using the basic cost efficiency model

	Community Banks	Non-Community Banks
AK	0.748	0.760
AL	0.757	0.776
AR	0.764	0.741
AZ	0.733	0.711
CA	0.753	0.776
CO	0.749	0.702
CT	0.803	0.746
DE	0.751	0.619
FL	0.750	0.740
GA	0.774	0.786
HI	0.710	0.815
IA	0.832	0.786
ID	0.735	0.698
IL	0.794	0.793
IN	0.770	0.747
KS	0.805	0.689
KY	0.775	0.750
LA	0.727	0.696
MA	0.799	0.722
MD	0.783	0.794
ME	0.769	0.723
MI	0.771	0.740
MN	0.817	0.789
MO	0.787	0.746
MS	0.769	0.735
MT	0.786	0.732
NC	0.780	0.783
ND	0.820	0.807
NE	0.829	0.757
NH	0.769	0.717
NJ	0.778	0.765
NM	0.711	0.715
NV	0.751	0.685
NY	0.775	0.765
OH	0.772	0.739
OK	0.754	0.695
OR	0.751	0.746
PA	0.778	0.761
RI	0.737	0.748
SC	0.768	0.755
SD	0.807	0.609
TN	0.762	0.758
TX	0.736	0.711
UT	0.726	0.698
VA	0.764	0.759
VT	0.762	0.776
WA	0.774	0.756
WI	0.820	0.791
WV	0.750	0.745
WY	0.765	0.753

NOTES: Table reports mean values and t tests for efficiency scores calculated using the basic cost frontier model for the two bank types. Mean values are reported by state. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively

Table 3.9: Second-stage regression results (dependent variable: Efficiency score calculated from the basic cost efficiency model)

	All banks		Community banks		Non-Community banks	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.084**	0.077**				
	(0.032)	(0.037)				
Total Assets (ln)	0.001	0.001	-0.005***	-0.005***	0.002***	0.001***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.105***	-0.105***	-0.177***	-0.164***	-0.001	-0.004
	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)
Credit risk	-0.001	-0.001	-0.001	-0.001**	-0.001***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan Loss Allowance / Loans	-0.913***	-0.782***	-0.616***	-0.563***	-0.760***	-0.733***
	(0.039)	(0.039)	(0.020)	(0.024)	(0.025)	(0.024)
Equity / Assets	-0.097***	-0.083***	-0.001	0.006	-0.172***	-0.191***
	(0.016)	(0.017)	(0.012)	(0.014)	(0.019)	(0.020)
Liquidity risk	-0.033***	-0.038***	-0.050***	-0.051***	-0.060***	-0.061***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
ROE	-0.025***	-0.028***	0.077***	0.074***	0.003	0.001
	(0.008)	(0.009)	(0.009)	(0.011)	(0.020)	(0.020)
z-score (ln)	0.003***	0.005***	0.005***	0.005***	0.016***	0.017***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cost / Income	-0.167***	-0.168***	-0.039***	-0.039**	-0.051*	-0.048
	(0.012)	(0.012)	(0.014)	(0.015)	(0.030)	(0.030)
Bank Holding Company	0.010***	0.011***	-0.006***	-0.006***	0.014***	0.016***
	(0.002)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Liquidity Creation	0.028***	0.039***	-0.059***	-0.046***	0.103***	0.105***
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Construction & Development Loans	0.024***	-0.002	-0.005**	-0.003	-0.082***	-0.088***
	(0.008)	(0.008)	(0.002)	(0.002)	(0.009)	(0.009)
Agricultural Loans	0.388***	0.381***	0.399***	0.388***	0.486***	0.495***
	(0.006)	(0.007)	(0.005)	(0.005)	(0.012)	(0.012)
Commercial Real Estate Loans	0.177***	0.180***	0.223***	0.211***	0.252***	0.251***
	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.006)
Commercial & Industrial Loans	0.326***	0.310***	0.273***	0.254***	0.325***	0.322***
	(0.005)	(0.006)	(0.002)	(0.003)	(0.007)	(0.007)
Residential Mortgages Loans	0.020***	0.017***	-0.082***	-0.069***	0.006	0.005
	(0.004)	(0.005)	(0.001)	(0.001)	(0.005)	(0.005)
Loans to Individuals	-0.023***	-0.029***	0.063***	0.050***	-0.030***	-0.033***
	(0.005)	(0.005)	(0.002)	(0.002)	(0.007)	(0.007)
Crisis		-0.001		0.001		0.005
		(0.001)		(0.001)		(0.004)
Policy Uncertainty Index (ln)		0.001***		0.001***		0.001
		(0.001)		(0.001)		(0.001)
Real GDP Growth		0.001		0.001***		0.001**
		(0.001)		(0.001)		(0.001)
Inflation		0.001		0.001***		0.002***
		(0.001)		(0.001)		(0.001)
Total Assets (ln) × CB	-0.006***	-0.006***				
	(0.001)	(0.001)				
Deposit / Assets × CB	-0.089***	-0.077***				
	(0.005)	(0.005)				
Credit risk × CB	-0.001	0.001				
	(0.001)	(0.001)				
Loan Loss Allowance / Loans × CB	0.424***	0.347***				

	(0.046)	(0.049)				
Equity / Assets × CB	0.170***	0.162***				
	(0.017)	(0.018)				
Liquidity risk × CB	-0.015***	-0.011***				
	(0.002)	(0.002)				
ROE × CB	0.109***	0.108***				
	(0.016)	(0.019)				
z-score (ln) × CB	-0.001	-0.001*				
	(0.001)	(0.001)				
Cost / Income × CB	0.122***	0.121***				
	(0.023)	(0.027)				
Bank Holding Company × CB	-0.015***	-0.015***				
	(0.002)	(0.003)				
Liquidity Creation × CB	-0.087***	-0.086***				
	(0.004)	(0.004)				
Real GDP Growth × CB		0.001				
		(0.001)				
Inflation × CB		0.001***				
		(0.001)				
Construction & Development Loans × CB	-0.034***	-0.004				
	(0.008)	(0.008)				
Agricultural Loans × CB	-0.006	-0.007				
	(0.010)	(0.011)				
Commercial Real Estate Loans × CB	0.030***	0.017***				
	(0.005)	(0.006)				
Commercial & Industrial Loans × CB	-0.076***	-0.074***				
	(0.005)	(0.005)				
Residential Mortgages Loans × CB	-0.092***	-0.077***				
	(0.005)	(0.005)				
Loans to Individuals × CB	0.065***	0.061***				
	(0.005)	(0.005)				
Constant	0.565***	0.559***	0.614***	0.601***	0.659***	0.660***
	(0.015)	(0.0164)	(0.020)	(0.023)	(0.036)	(0.037)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.1864	0.1791	0.1791	0.1704	0.2496	0.2460
Log Pseudolikelihood	1177103.2	1108552.5	1057817.3	998236.79	127367.46	118882.63
Observations	993,479	908,653	890,029	810,642	128,271	118,221

NOTES: The table presents second-stage regression results for the efficiency score calculated from the basic cost efficiency model. Model I includes only bank- specific variables and Model II includes both bank- specific and macroeconomic variables. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Appendix 3.1

Table A3.1. FDIC Community bank definition.

Exclude	**Include**
Organisations with:	Remaining organisations with:

• 50% or more of their Assets within a specialty organization such as:
    ○ Credit card specialists
    ○ Consumer nonbank banks
    ○ Industrial loan companies
    ○ Trust companies
    ○ Banker's banks
	• Loans/Assets > 33%
	• Core Deposits/Assets > 50%
	• At least one office but fewer than an indexed maximum number of offices*
	• Offices in no more than 3 states and no more than 2 large metropolitan areas
	• No single office with deposits above an indexed maximum deposit size*

• Foreign assets ≥ 10% of Total assets	Total Assets < indexed size threshold*
• No loans or no core deposits	*Adjusted over time ▪ The maximum number of offices was 40 in 1985 and 75 in 2010. ▪ The maximum deposit size per branch was $1.25 billion in 1985 and $5 billion in 2010. ▪ The assets size threshold was $250 million in 1985 and $1 billion in 2010.

NOTES: Source: FDIC. Aggregate charter-level data at banking organization level. If a banking organization is reported as a community bank, every bank under that organization is considered a Community Bank.

Table A3.2: Credit risk, liquidity risk and financial stability proxy variables.

Category	**Proxy**	**Calculation**	**Values**
Credit Risk	Imbierowicz and Rauch (2014) measure (CR)	$CR_t = \frac{Loan\ charge-offs_t - Loan\ Recoveries_t}{Loan\ Loss\ Allowance_t}$	Values above 1 indicate unexpected losses
Liquidity Risk	Imbierowicz and Rauch (2014) measure (LR)	$LR_t = [(\text{Demand Deposits}_t + \text{Transaction Deposits}_t + \text{Brokered Deposits}_t + \text{NOW Accounts}_t + \text{Unused Loan Commitments}_t) - (\text{Cash}_t + \text{Currency \& Coin}_t + \text{Trading Assets}_t + \text{Fed Funds Purchased}_t + \text{Commercial Paper}_t + \text{Securities available for Sale}_t) \pm \text{Net Interbank Lending Position}_t \pm \text{Net Interbank Acceptances}_t \pm \text{Net Derivative Position}_t] \frac{1}{Total\ Assets_t}$	Values above zero imply that the bank is ceteris paribus not able to endure a sudden bank run
Financial Stability	Z-score (Cihák and Hesse, 2007)	$Z-score_t = \frac{\frac{Equity_t}{Assets_t} + ROA_t}{\sigma(ROA_T)}$	Higher values indicate higher stability

NOTES: The table displays descriptions and calculations of the three proxy variables for credit risk, liquidity risk and financial stability. The credit risk proxy is calculated by dividing the net loan charge-offs by the loan loss allowance in the previous year. It indicates the degree to which the current period losses were expected in the period before. The liquidity risk proxy is standardised by total assets and indicates to what degree the bank is able to cover sudden and unexpected liquidity demand with liquid assets. The Z-score is calculated as the sum of the return on assets and the ratio of equity to total assets divided by the standard deviation of the return on assets. Because of its high skewness, we use its natural logarithm (Laeven and Levine, 2009). It measures a bank's distance to insolvency and it is inversely related to the probability of default.

Table A3.3: Cost Frontier

	Ln (TC/p3)
p1/p3	0.001***
	(0.001)
p2/p3	0.001
	(0.001)
Ln(p1/p3)	0.766***
	(0.005)
Ln(p2/p3)	-0.093***
	(0.003)
Ln(y1)	-0.430***
	(0.004)
Ln(y2)	0.225***
	(0.002)
0.5* Ln(y1)* Ln(y1)	0.085***
	(0.001)
Ln(y1)* Ln(y2)	-0.013***
	(0.001)
0.5* Ln(y2)* Ln(y2)	0.019***
	(0.001)
0.5* Ln(p1/p3)* Ln(p1/p3)	-0.080***
	(0.001)
Ln(p1/p3)* Ln(p2/p3)	0.052***
	(0.001)
0.5* Ln(p2/p3) * Ln(p2/p3)	-0.023***
	(0.001)
Ln(p1/p3)* Ln(y1)	0.044***
	(0.001)
Ln(p1/p3)* Ln(y2)	-0.013***
	(0.001)
Ln(p2/p3)*Ln(y2)	0.002***
	(0.001)
Ln(p2/p3)*Ln(y1)	-0.021***
	(0.001)
Constant	4.718***
	(0.032)
R^2	0.9386
Observations	1,029,723

NOTES: Table reports the coefficients and robust standard errors in parentheses for the Panel Translog Cost Frontier. We follow the approach of Kumbhakar et al. (2014) and divide the efficiency into persistent and residual. Time effects are included but not reported for brevity. . ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table A3.4i: Second-stage regression results by period (Pre-Basel I and pre-FDICIA, 1984-1990).

	All banks		Community banks		Non-Community banks	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.157***	0.156***				
	(0.013)	(0.014)				
Total Assets (ln)	-0.013***	-0.013***	-0.028***	-0.028***	-0.014***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.102***	-0.104***	-0.104***	-0.109***	-0.122***	-0.121***
	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.007)
Credit risk	-0.004***	-0.007***	-0.003***	-0.003***	-0.004***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan Loss Allowance / Loans	-0.087**	-0.062	-0.185***	-0.184***	0.023	0.033
	(0.041)	(0.044)	(0.010)	(0.010)	(0.043)	(0.045)
Equity / Assets	0.038	0.065***	0.051***	0.049***	0.014	0.0312
	(0.026)	(0.024)	(0.007)	(0.008)	(0.025)	(0.023)
Liquidity risk	-0.026***	-0.025***	0.004***	0.005***	-0.028***	-0.027***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
ROE	-0.015***	-0.020***	0.006**	0.006*	-0.011***	-0.014***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
z-score (ln)	0.005***	0.005***	0.003***	0.0032***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cost / Income	-0.116***	-0.118***	-0.074***	-0.073***	-0.119***	-0.118***
	(0.005)	(0.005)	(0.006)	(0.007)	(0.005)	(0.005)
Bank Holding Company	0.020***	0.018***	0.001	0.001	0.021***	0.019***
	(0.004)	(0.005)	(0.001)	(0.001)	(0.004)	(0.005)
Liquidity Creation	0.070***	0.070***	-0.064***	-0.066***	0.064***	0.066***
	(0.005)	(0.006)	(0.002)	(0.002)	(0.005)	(0.006)
Construction & Development Loans	-0.006	-0.013	-0.022***	-0.020***	-0.002	-0.005
	(0.008)	(0.008)	(0.003)	(0.003)	(0.008)	(0.009)
Agricultural Loans	0.244***	0.256***	0.211***	0.216***	0.246***	0.254***
	(0.007)	(0.008)	(0.003)	(0.003)	(0.008)	(0.009)
Commercial Real Estate Loans	0.034***	0.037***	0.139***	0.140***	0.049***	0.048***
	(0.006)	(0.007)	(0.002)	(0.002)	(0.006)	(0.007)
Commercial & Industrial Loans	0.087***	0.088***	0.149***	0.152***	0.083***	0.082***
	(0.006)	(0.007)	(0.002)	(0.002)	(0.006)	(0.007)
Residential Mortgages Loans	0.069***	0.067***	-0.026***	-0.026***	0.058***	0.055***
	(0.005)	(0.006)	(0.002)	(0.002)	(0.005)	(0.006)
Loans to Individuals	-0.032***	-0.031***	0.045***	0.047***	-0.012***	-0.015***
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.005)
Policy Uncertainty Index (ln)		-0.002***		-0.002***		-0.003
		(0.001)		(0.001)		(0.002)
Real GDP Growth		-0.035***		-0.016***		-0.059***
		(0.012)		(0.006)		(0.020)
Inflation		-0.215***		-0.021		-0.010
		(0.028)		(0.014)		(0.039)
Total Assets (ln) × CB	-0.015***	-0.016***				
	(0.001)	(0.001)				
Deposit / Assets × CB	-0.005	-0.008				
	(0.007)	(0.008)				
Credit risk × CB	0.002***	0.004***				
	(0.001)	(0.001)				
Loan Loss Allowance / Loans × CB	-0.082*	-0.107**				
	(0.042)	(0.044)				
Equity / Assets × CB	0.012	-0.018				

	(0.027)	(0.025)				
Liquidity risk × CB	0.031***	0.031***				
	(0.003)	(0.003)				
ROE × CB	0.021***	0.026***				
	(0.005)	(0.005)				
z-score (ln) × CB	-0.002***	-0.003***				
	(0.001)	(0.001)				
Cost / Income × CB	0.044***	0.046***				
	(0.008)	(0.008)				
Bank Holding Company × CB	-0.020***	-0.018***				
	(0.004)	(0.005)				
Liquidity Creation × CB	-0.133***	-0.135***				
	(0.005)	(0.006)				
Real GDP Growth × CB		0.012				
		(0.011)				
Inflation × CB		0.225***				
		(0.028)				
Construction & Development Loans × CB	-0.018**	-0.008				
	(0.008)	(0.009)				
Agricultural Loans × CB	-0.033***	-0.039***				
	(0.007)	(0.008)				
Commercial Real Estate Loans × CB	0.109***	0.106***				
	(0.006)	(0.007)				
Commercial & Industrial Loans × CB	0.061***	0.064***				
	(0.006)	(0.007)				
Residential Mortgages Loans × CB	-0.097***	-0.095***				
	(0.005)	(0.006)				
Loans to Individuals × CB	0.074***	0.076***				
	(0.004)	(0.004)				
Constant	0.986***	1.006***	1.137***	1.153***	1.037***	1.055***
	(0.010)	(0.012)	(0.009)	(0.012)	(0.011)	(0.019)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.2262	0.2254	0.2134	0.2119	0.1514	0.1512
Log Pseudolikelihood	562,616	489,232	494,940	430,284	76,192	66,592
Observations	284,979	248,531	240,478	209,428	44,501	39,103

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank- specific variables and Model II includes both bank- specific and macroeconomic variables. The dependent variable is the Overall Efficiency score. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table A3.4ii: Second-stage regression results by period (Pre-FMA 1999, 1991-1999).

	All banks		Community banks		Non-Community banks	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.138***	0.137***				
	(0.020)	(0.021)				
Total Assets (ln)	-0.013***	-0.013***	-0.031***	-0.031***	-0.014***	-0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.126***	-0.125***	-0.111***	-0.111***	-0.133***	-0.133***
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Credit risk	-0.011***	-0.012***	-0.010***	-0.010***	-0.014***	-0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan Loss Allowance / Loans	-0.107***	-0.113***	-0.204***	-0.204***	-0.117***	-0.119***
	(0.031)	(0.031)	(0.010)	(0.010)	(0.031)	(0.031)
Equity / Assets	-0.191***	-0.186***	0.0589***	0.058***	-0.209***	-0.209***
	(0.020)	(0.020)	(0.006)	(0.006)	(0.020)	(0.020)
Liquidity risk	-0.007***	-0.009***	-0.012***	-0.012***	-0.011***	-0.011***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
ROE	-0.015	-0.016	0.069***	0.070***	-0.011	-0.013
	(0.011)	(0.012)	(0.005)	(0.005)	(0.012)	(0.012)
z-score (ln)	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cost / Income	-0.106***	-0.108***	-0.007	-0.008	-0.110***	-0.110***
	(0.016)	(0.016)	(0.007)	(0.007)	(0.018)	(0.018)
Bank Holding Company	0.015***	0.015***	-0.002***	-0.002***	0.022***	0.022***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Liquidity Creation	-0.024***	-0.022***	-0.064***	-0.064***	-0.010*	-0.010*
	(0.006)	(0.006)	(0.002)	(0.002)	(0.005)	(0.005)
Construction & Development Loans	0.054***	0.055***	0.007***	0.007***	0.021**	0.021**
	(0.010)	(0.010)	(0.003)	(0.003)	(0.011)	(0.011)
Agricultural Loans	0.265***	0.265***	0.193***	0.193***	0.301***	0.301***
	(0.008)	(0.008)	(0.003)	(0.003)	(0.009)	(0.010)
Commercial Real Estate Loans	0.076***	0.075***	0.118***	0.118***	0.075***	0.075***
	(0.007)	(0.006)	(0.002)	(0.002)	(0.006)	(0.006)
Commercial & Industrial Loans	0.225***	0.223***	0.154***	0.154***	0.208***	0.208***
	(0.006)	(0.006)	(0.002)	(0.002)	(0.007)	(0.007)
Residential Mortgages Loans	0.038***	0.038***	-0.031***	-0.031***	0.039***	0.039***
	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.006)
Loans to Individuals	-0.020***	-0.021***	0.026***	0.0262***	-0.010**	-0.010**
	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Policy Uncertainty Index (ln)		0.003***		0.003***		0.001
		(0.001)		(0.001)		(0.002)
Real GDP Growth		-0.056***		0.007		-0.028
		(0.017)		(0.005)		(0.017)
Inflation		0.108**		0.023		-0.175***
		(0.049)		(0.017)		(0.060)
Total Assets (ln) × CB	-0.019***	-0.019***				
	(0.001)	(0.001)				
Deposit / Assets × CB	0.012***	0.012**				
	(0.005)	(0.005)				
Credit risk × CB	0.001	0.001				
	(0.001)	(0.001)				
Loan Loss Allowance / Loans × CB	-0.097***	-0.090***				
	(0.033)	(0.033)				
Equity / Assets × CB	0.245***	0.239***				

	(0.021)	(0.020)				
Liquidity risk × CB	-0.005***	-0.003*				
	(0.002)	(0.002)				
ROE × CB	0.085***	0.086***				
	(0.012)	(0.013)				
z-score (ln) × CB	0.001	0.001				
	(0.001)	(0.001)				
Cost / Income × CB	0.098***	0.100***				
	(0.017)	(0.018)				
Bank Holding Company × CB	-0.017***	-0.017***				
	(0.003)	(0.003)				
Liquidity Creation × CB	-0.040***	-0.043***				
	(0.006)	(0.006)				
Real GDP Growth × CB		0.067***				
		(0.018)				
Inflation × CB		-0.127**				
		(0.050)				
Construction & Development Loans × CB	-0.049***	-0.049***				
	(0.010)	(0.010)				
Agricultural Loans × CB	-0.069***	-0.069***				
	(0.009)	(0.009)				
Commercial Real Estate Loans × CB	0.043***	0.044***				
	(0.007)	(0.007)				
Commercial & Industrial Loans × CB	-0.071***	-0.069***				
	(0.007)	(0.007)				
Residential Mortgages Loans × CB	-0.068***	-0.069***				
	(0.006)	(0.006)				
Loans to Individuals × CB	0.047***	0.048***				
	(0.005)	(0.005)				
Constant	1.001***	0.984***	1.132***	1.111***	1.034***	1.034***
	(0.018)	(0.019)	(0.011)	(0.013)	(0.020)	(0.027)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.2756	0.2757	0.2702	0.2703	0.1704	0.1705
Log Pseudolikelihood	622,683	622,732	561,908	561,930	68,595	68,601
Observations	308,973	308,973	269,207	269,207	39,766	39,766

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank-specific variables and Model II includes both bank- specific and macroeconomic variables. The dependent variable is the Overall Efficiency score. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table A3.4iii: Second-stage regression results by period (Pre-Basel III and pre-DFA 2010, 2000-2010).

	All banks		Community banks		Non-Community banks	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.306***	0.300***				
	(0.022)	(0.024)				
Total Assets (ln)	-0.007***	-0.007***	-0.030***	-0.030***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.120***	-0.120***	-0.110***	-0.110***	-0.122***	-0.122***
	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Credit risk	-0.012***	-0.014***	-0.010***	-0.010***	-0.012***	-0.014***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Loan Loss Allowance / Loans	-0.635***	-0.655***	-0.342***	-0.346***	-0.650***	-0.656***
	(0.071)	(0.072)	(0.021)	(0.021)	(0.070)	(0.070)
Equity / Assets	-0.017	-0.017	0.009	0.009	-0.038*	-0.039**
	(0.019)	(0.019)	(0.007)	(0.007)	(0.020)	(0.020)
Liquidity risk	-0.009***	-0.008**	-0.030***	-0.030***	-0.015***	-0.015***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
ROE	-0.028	-0.032*	0.027***	0.024***	-0.032*	-0.038**
	(0.018)	(0.019)	(0.007)	(0.007)	(0.018)	(0.019)
z-score (ln)	-0.002*	-0.002*	-0.004***	-0.004***	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cost / Income	-0.090***	-0.091***	-0.056***	-0.056***	-0.091***	-0.092***
	(0.016)	(0.016)	(0.007)	(0.007)	(0.016)	(0.017)
Bank Holding Company	-0.009***	-0.009***	-0.008***	-0.008***	-0.007**	-0.007**
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Liquidity Creation	0.077***	0.077***	-0.009***	-0.009***	0.078***	0.078***
	(0.006)	(0.006)	(0.002)	(0.002)	(0.006)	(0.006)
Construction & Development Loans	-0.072***	-0.071***	0.022***	0.022***	-0.080***	-0.080***
	(0.007)	(0.007)	(0.002)	(0.002)	(0.008)	(0.008)
Agricultural Loans	0.083***	0.082***	0.096***	0.095***	0.123***	0.122***
	(0.009)	(0.009)	(0.002)	(0.002)	(0.011)	(0.011)
Commercial Real Estate Loans	0.054***	0.053***	0.046***	0.046***	0.053***	0.053***
	(0.005)	(0.006)	(0.002)	(0.002)	(0.006)	(0.006)
Commercial & Industrial Loans	0.079***	0.081***	0.037***	0.037***	0.082***	0.082***
	(0.008)	(0.008)	(0.003)	(0.003)	(0.012)	(0.012)
Residential Mortgages Loans	0.028***	0.028***	-0.050***	-0.050***	0.032***	0.032***
	(0.005)	(0.005)	(0.002)	(0.001)	(0.006)	(0.006)
Loans to Individuals	-0.051***	-0.049***	-0.051***	-0.051***	-0.051***	-0.050***
	(0.007)	(0.007)	(0.003)	(0.003)	(0.008)	(0.008)
Policy Uncertainty Index (ln)		0.004***		0.004***		0.004
		(0.001)		(0.001)		(0.003)
Real GDP Growth		-0.001		-0.009**		-0.0169
		(0.017)		(0.004)		(0.0195)
Inflation		-0.223***		-0.057***		-0.213***
		(0.049)		(0.018)		(0.0683)
Total Assets (ln) × CB	-0.023***	-0.023***				
	(0.001)	(0.001)				
Deposit / Assets × CB	0.007	0.008*				
	(0.005)	(0.005)				
Credit risk × CB	0.002	0.004*				
	(0.002)	(0.002)				
Loan Loss Allowance / Loans × CB	0.298***	0.314***				
	(0.074)	(0.076)				
Equity / Assets × CB	0.022	0.022				

	(0.020)	(0.020)				
Liquidity risk × CB	-0.021***	-0.021***				
	(0.003)	(0.003)				
ROE × CB	0.055***	0.056***				
	(0.019)	(0.020)				
z-score (ln) × CB	-0.002*	-0.002				
	(0.001)	(0.001)				
Cost / Income × CB	0.034**	0.035**				
	(0.017)	(0.018)				
Bank Holding Company × CB	0.001	0.001				
	(0.003)	(0.003)				
Liquidity Creation × CB	-0.086***	-0.086***				
	(0.006)	(0.006)				
Real GDP Growth × CB		-0.010				
		(0.017)				
Inflation × CB		0.166***				
		(0.050)				
Construction & Development Loans × CB	0.094***	0.092***				
	(0.007)	(0.007)				
Agricultural Loans × CB	0.015	0.015				
	(0.009)	(0.010)				
Commercial Real Estate Loans × CB	-0.009*	-0.009				
	(0.006)	(0.006)				
Commercial & Industrial Loans × CB	-0.039***	-0.041***				
	(0.008)	(0.009)				
Residential Mortgages Loans × CB	-0.074***	-0.075***				
	(0.005)	(0.006)				
Loans to Individuals × CB	-0.001	-0.003				
	(0.007)	(0.007)				
Constant	0.951***	0.940***	1.252***	1.235***	0.982***	0.967***
	(0.020)	(0.021)	(0.011)	(0.011)	(0.022)	(0.027)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.2084	0.2086	0.2115	0.2116	0.1538	0.1541
Log Pseudolikelihood	536,056	536,130	512,274	512,323	33,378	33,387
Observations	287,157	287,157	264,076	264,076	23,081	23,081

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank- specific variables and Model II includes both bank- specific and macroeconomic variables. The dependent variable is the Overall Efficiency score. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table A3.4iv: Second-stage regression results by period (Post-DFA, 2011-2013).

	All banks		Community banks		Non-Community	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.224***	0.450***				
	(0.037)	(0.050)				
Total Assets (ln)	0.003***	0.003*	-0.025***	-0.029***	0.001	0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Deposit / Assets	-0.259***	-0.189***	-0.185***	-0.174***	-0.240***	-0.171***
	(0.022)	(0.032)	(0.006)	(0.008)	(0.023)	(0.033)
Credit risk	0.0015	0.003	-0.008***	-0.013***	-0.010**	0.008
	(0.005)	(0.006)	(0.001)	(0.002)	(0.005)	(0.007)
Loan Loss Allowance / Loans	-1.197***	-1.341***	-0.683***	-0.541***	-1.147***	-1.377***
	(0.156)	(0.239)	(0.030)	(0.044)	(0.155)	(0.248)
Equity / Assets	-0.073*	0.076	-0.022	-0.052**	-0.165***	0.010
	(0.042)	(0.071)	(0.018)	(0.023)	(0.041)	(0.069)
Liquidity risk	0.043***	0.048***	-0.024***	-0.028***	0.037***	0.044***
	(0.008)	(0.012)	(0.002)	(0.003)	(0.008)	(0.012)
ROE	-0.179***	-0.022	0.120***	0.019	-0.155***	-0.027
	(0.027)	(0.038)	(0.016)	(0.016)	(0.026)	(0.039)
z-score (ln)	-0.012***	-0.013***	-0.008***	-0.010***	-0.009***	-0.011**
	(0.003)	(0.005)	(0.001)	(0.001)	(0.003)	(0.005)
Cost / Income	-0.170***	-0.083***	-0.021*	-0.099***	-0.163***	-0.079***
	(0.015)	(0.018)	(0.012)	(0.014)	(0.016)	(0.019)
Bank Holding Company	-0.013	-0.007	-0.015***	-0.014***	-0.009	-0.011
	(0.009)	(0.013)	(0.001)	(0.001)	(0.009)	(0.014)
Liquidity Creation	0.074***	0.020	-0.088***	-0.057***	0.095***	0.022
	(0.016)	(0.022)	(0.004)	(0.005)	(0.016)	(0.024)
Construction & Development Loans	-0.250***	-0.261***	0.004	0.031**	-0.337***	-0.306***
	(0.050)	(0.070)	(0.009)	(0.013)	(0.061)	(0.088)
Agricultural Loans	0.129***	0.155***	0.230***	0.156***	0.118***	0.157***
	(0.020)	(0.032)	(0.007)	(0.009)	(0.029)	(0.0426)
Commercial Real Estate Loans	0.073***	0.052***	0.123***	0.088***	0.083***	0.072***
	(0.013)	(0.020)	(0.004)	(0.005)	(0.014)	(0.022)
Commercial & Industrial Loans	—	—	—	—	—	—
Residential Mortgages Loans	-0.100***	-0.086***	-0.133***	-0.094***	-0.109***	-0.084***
	(0.020)	(0.027)	(0.005)	(0.006)	(0.023)	(0.031)
Loans to Individuals	0.007	-0.077	-0.017**	-0.055***	0.009	-0.043
	(0.035)	(0.053)	(0.008)	(0.011)	(0.033)	(0.054)
Policy Uncertainty Index (ln)		0.025***		0.026***		-0.020
		(0.006)		(0.006)		(0.034)
Real GDP Growth		-0.413***		-0.288***		0.0386
		(0.156)		(0.067)		(0.359)
Inflation		0.124		-0.168***		0.275
		(0.235)		(0.049)		(0.257)
Total Assets (ln) × CB	-0.028***	-0.032***				
	(0.001)	(0.002)				
Deposit / Assets × CB	0.074***	0.015				
	(0.023)	(0.033)				
Credit risk × CB	-0.009*	-0.016**				
	(0.005)	(0.006)				
Loan Loss Allowance / Loans × CB	0.502***	0.788***				
	(0.159)	(0.243)				
Equity / Assets × CB	0.044	-0.134*				

	(0.046)	(0.075)				
Liquidity risk × CB	-0.067***	-0.076***				
	(0.008)	(0.012)				
ROE × CB	0.298***	0.041				
	(0.032)	(0.041)				
z-score (ln) × CB	0.005	0.003				
	(0.003)	(0.005)				
Cost / Income × CB	0.149***	-0.016				
	(0.019)	(0.023)				
Bank Holding Company × CB	-0.002	-0.006				
	(0.009)	(0.013)				
Liquidity Creation × CB	-0.162***	-0.080***				
	(0.016)	(0.023)				
Real GDP Growth × CB		0.001				
		(0.002)				
Inflation × CB		-0.003				
		(0.002)				
Construction & Development Loans × CB	0.248***	0.289***				
	(0.050)	(0.071)				
Agricultural Loans × CB	0.098***	-0.001				
	(0.021)	(0.033)				
Commercial Real Estate Loans × CB	0.049***	0.036*				
	(0.013)	(0.021)				
Commercial & Industrial Loans × CB	—	—				
Residential Mortgages Loans × CB	-0.032	-0.007				
	(0.020)	(0.027)				
Loans to Individuals × CB	-0.025	0.022				
	(0.036)	(0.054)				
Constant	1.047***	0.796***	1.269***	1.236***	1.110***	1.089***
	(0.030)	(0.057)	(0.022)	(0.034)	(0.034)	(0.204)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.2065	0.2294	0.1956	0.2252	0.2425	0.1902
Log Pseudolikelihood	93,736	36,134	90,239	34,848	4,261	1,608
Observations	61,040	21,419	57,616	20,228	3,424	1,191

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank-specific variables and Model II includes both bank- specific and macroeconomic variables. The dependent variable is the Overall Efficiency score. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table A3.5: Second-stage regression results, balanced sample.

	All banks		Community banks		Non-Community	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.298***	0.321***				
	(0.0169)	(0.017)				
Total Assets (ln)	0.005***	0.005***	-0.031***	-0.031***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.151***	-0.137***	-0.134***	-0.126***	-0.092***	-0.089***
	(0.008)	(0.008)	(0.002)	(0.002)	(0.008)	(0.008)
Credit risk	-0.008***	-0.010***	-0.004***	-0.004***	-0.010***	-0.009**
	(0.003)	(0.003)	(0.001)	(0.001)	(0.004)	(0.004)
Loan Loss Allowance / Loans	0.027	0.155	-0.291***	-0.239***	0.239	0.332*
	(0.114)	(0.125)	(0.012)	(0.012)	(0.167)	(0.181)
Equity / Assets	-0.086**	-0.065*	0.039***	0.068***	0.172***	0.200***
	(0.035)	(0.038)	(0.008)	(0.007)	(0.040)	(0.043)
Liquidity risk	0.020***	0.006	-0.019***	-0.019***	0.015***	-0.006
	(0.004)	(0.004)	(0.001)	(0.001)	(0.005)	(0.006)
ROE	-0.032***	-0.017	0.071***	0.070***	-0.038***	-0.021
	(0.012)	(0.012)	(0.004)	(0.004)	(0.013)	(0.014)
z-score (ln)	-0.014***	-0.014***	0.002***	0.001***	-0.014***	-0.014***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Cost / Income	-0.105***	-0.097***	-0.006	-0.005	-0.151***	-0.146***
	(0.009)	(0.010)	(0.006)	(0.005)	(0.010)	(0.010)
Bank Holding Company	0.002	0.008	-0.003***	-0.003***	-0.039***	-0.043***
	(0.006)	(0.006)	(0.001)	(0.001)	(0.007)	(0.008)
Liquidity Creation	-0.046***	-0.036***	-0.069***	-0.057***	-0.051***	-0.036***
	(0.007)	(0.007)	(0.001)	(0.001)	(0.010)	(0.010)
Construction & Development Loans	-0.074***	-0.140***	-0.008***	-0.010***	-0.021	-0.027
	(0.019)	(0.019)	(0.003)	(0.003)	(0.022)	(0.022)
Agricultural Loans	0.147***	0.113***	0.188***	0.174***	0.121***	0.195***
	(0.027)	(0.030)	(0.002)	(0.002)	(0.038)	(0.043)
Commercial Real Estate Loans	-0.022**	0.005	0.098***	0.090***	-0.025*	-0.014
	(0.011)	(0.011)	(0.002)	(0.002)	(0.013)	(0.013)
Commercial & Industrial Loans	0.139***	0.135***	0.121***	0.105***	0.015	0.0047
	(0.009)	(0.010)	(0.002)	(0.002)	(0.015)	(0.015)
Residential Mortgages Loans	0.095***	0.070***	-0.042***	-0.034***	0.103***	0.081***
	(0.012)	(0.012)	(0.002)	(0.001)	(0.013)	(0.013)
Loans to Individuals	-0.108***	-0.108***	0.018***	0.011***	-0.169***	-0.130***
	(0.012)	(0.012)	(0.001)	(0.002)	(0.015)	(0.015)
Crisis		-0.001		-0.001		0.001
		(0.001)		(0.001)		(0.005)
Policy Uncertainty Index (ln)		0.001*		0.001*		0.002
		(0.001)		(0.001)		(0.005)
Real GDP Growth		-0.043*		0.019***		-0.015
		(0.024)		(0.004)		(0.031)
Inflation		0.187***		0.097***		-0.096
		(0.065)		(0.013)		(0.097)
Total Assets (ln) × CB	-0.035***	-0.035***				
	(0.001)	(0.001)				
Deposit / Assets × CB	0.017**	0.011				
	(0.008)	(0.008)				
Credit risk × CB	0.004	0.006*				
	(0.003)	(0.003)				
Loan Loss Allowance / Loans × CB	-0.310***	-0.387***				

	(0.114)	(0.125)				
Equity / Assets × CB	0.125***	0.132***				
	(0.036)	(0.039)				
Liquidity risk × CB	-0.039***	-0.025***				
	(0.004)	(0.004)				
ROE × CB	0.103***	0.087***				
	(0.012)	(0.012)				
z-score (ln) × CB	0.016***	0.015***				
	(0.002)	(0.002)				
Cost / Income × CB	0.099***	0.092***				
	(0.010)	(0.011)				
Bank Holding Company × CB	-0.005	-0.011*				
	(0.006)	(0.006)				
Liquidity Creation × CB	-0.023***	-0.022***				
	(0.007)	(0.007)				
Real GDP Growth × CB		0.063**				
		(0.024)				
Inflation × CB		-0.101				
		(0.065)				
Construction & Development Loans × CB	0.066***	0.130***				
	(0.019)	(0.019)				
Agricultural Loans × CB	0.042	0.062**				
	(0.027)	(0.030)				
Commercial Real Estate Loans × CB	0.120***	0.085***				
	(0.011)	(0.011)				
Commercial & Industrial Loans × CB	-0.019**	-0.030***				
	(0.009)	(0.010)				
Residential Mortgages Loans × CB	-0.138***	-0.104***				
	(0.012)	(0.012)				
Loans to Individuals × CB	0.126***	0.119***				
	(0.012)	(0.012)				
Constant	0.863***	0.829***	1.161***	1.150***	0.889***	0.872***
	(0.015)	(0.017)	(0.008)	(0.007)	(0.020)	(0.036)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.2716	0.2809	0.2717	0.2818	0.2194	0.2277
Log Pseudolikelihood	517,219	483,004	508,117	475,038	13,181	12,067
Observations	251,110	227,348	243,217	220,336	7,893	7,012

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank-specific variables and Model II includes both bank- specific and macroeconomic variables. The dependent variable is the Overall Efficiency score. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table A3.6: Second-stage regression results using the asset-based definition of Community Banks

	All banks		Community banks		Non-Community	
	Model I	Model II	Model I	Model II	Model I	Model II
Community Bank	0.428***	0.471***				
	(0.037)	(0.039)				
Total Assets (ln)	0.008***	0.009***	-0.029***	-0.029***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposit / Assets	-0.137***	-0.124***	-0.106***	-0.104***	-0.131***	-0.123***
	(0.006)	(0.006)	(0.001)	(0.001)	(0.005)	(0.005)
Credit risk	-0.012***	-0.011***	-0.005***	-0.005***	-0.011***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan Loss Allowance / Loans	-0.422***	-0.229***	-0.310***	-0.270***	-0.268***	-0.168***
	(0.058)	(0.061)	(0.012)	(0.016)	(0.048)	(0.051)
Equity / Assets	-0.325***	-0.284***	0.033***	0.034***	-0.251***	-0.234***
	(0.034)	(0.036)	(0.003)	(0.004)	(0.028)	(0.030)
Liquidity risk	0.017***	0.007**	-0.021***	-0.021***	0.010***	0.001
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.004)
ROE	-0.006	0.004	0.048***	0.044***	-0.010	-0.003
	(0.019)	(0.020)	(0.009)	(0.012)	(0.020)	(0.021)
z-score (ln)	-0.001	0.001	0.001***	0.001***	0.002*	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cost / Income	-0.089***	-0.082***	-0.025*	-0.026*	-0.095***	-0.088***
	(0.029)	(0.030)	(0.013)	(0.0162)	(0.032)	(0.033)
Bank Holding Company	-0.014***	-0.015***	-0.004***	-0.003**	-0.011***	-0.013***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)
Liquidity Creation	0.019***	0.025***	-0.024***	-0.021***	0.045***	0.045***
	(0.006)	(0.007)	(0.001)	(0.002)	(0.006)	(0.006)
Construction & Development Loans	-0.029**	-0.036***	0.008***	0.012***	-0.009	0.001
	(0.011)	(0.012)	(0.001)	(0.001)	(0.010)	(0.011)
Agricultural Loans	-0.160***	-0.172***	0.159***	0.155***	-0.080**	-0.124***
	(0.028)	(0.032)	(0.004)	(0.004)	(0.033)	(0.039)
Commercial Real Estate Loans	0.127***	0.130***	0.092***	0.087***	0.129***	0.122***
	(0.007)	(0.007)	(0.001)	(0.002)	(0.006)	(0.006)
Commercial & Industrial Loans	0.195***	0.190***	0.097***	0.094***	0.135***	0.146***
	(0.010)	(0.011)	(0.001)	(0.002)	(0.010)	(0.010)
Residential Mortgages Loans	-0.121***	-0.109***	-0.041***	-0.035***	-0.080***	-0.056***
	(0.008)	(0.008)	(0.001)	(0.001)	(0.008)	(0.008)
Loans to Individuals	-0.059***	-0.056***	0.001	-0.001	-0.087***	-0.080***
	(0.007)	(0.007)	(0.002)	(0.002)	(0.007)	(0.008)
Crisis		-0.001**		-0.001**		-0.002
		(0.001)		(0.001)		(0.004)
Policy Uncertainty Index (ln)		0.001***		0.001***		0.002
		(0.001)		(0.001)		(0.003)
Real GDP Growth		0.001		0.001		-0.001
		(0.001)		(0.001)		(0.001)
Inflation		0.003***		0.00		-0.001
		(0.001)		(0.001)		(0.001)
Total Assets (ln) × CB	-0.038***	-0.039***				
	(0.001)	(0.001)				
Deposit / Assets × CB	0.030***	0.019***				
	(0.006)	(0.006)				
Credit risk × CB	0.006***	0.006**				
	(0.001)	(0.001)				
Loan Loss Allowance / Loans × CB	0.115*	-0.039				

	(0.060)	(0.064)				
Equity / Assets × CB	(0.034)	0.318***				
	(0.034)	(0.037)				
Liquidity risk × CB	-0.038***	-0.028***				
	(0.003)	(0.003)				
ROE × CB	0.054**	0.040*				
	(0.022)	(0.023)				
z-score (ln) × CB	0.001	0.001				
	(0.001)	(0.001)				
Cost / Income × CB	0.063**	0.055				
	(0.031)	(0.034)				
Bank Holding Company × CB	0.010***	0.012***				
	(0.003)	(0.003)				
Liquidity Creation × CB	-0.044***	-0.047***				
	(0.006)	(0.007)				
Real GDP Growth × CB		-0.001				
		(0.001)				
Inflation × CB		-0.003***				
		(0.001)				
Construction & Development Loans × CB	0.038***	0.048***				
	(0.011)	(0.012)				
Agricultural Loans × CB	0.320***	0.327***				
	(0.029)	(0.033)				
Commercial Real Estate Loans × CB	-0.034***	-0.041***				
	(0.007)	(0.008)				
Commercial & Industrial Loans × CB	-0.097***	-0.096***				
	(0.010)	(0.011)				
Residential Mortgages Loans × CB	0.080***	0.073***				
	(0.008)	(0.008)				
Loans to Individuals × CB	0.060***	0.055***				
	(0.007)	(0.007)				
Constant	0.729***	0.678***	1.156***	1.148***	0.722***	0.691***
	(0.032)	(0.033)	(0.018)	(0.024)	(0.037)	(0.046)
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Pseudo R2	0.2320	0.2396	0.2284	0.2362	0.1762	0.1804
Log Pseudolikelihood	1,785,575	1,668,566	1,763,239	1,648,008	27,288	25,204
Observations	941,179	865,030	924,097	849,567	17,082	15,463

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank-specific variables and Model II includes both bank- specific and macroeconomic variables. The dependent variable is the Overall Efficiency score. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Table A3.7: Second-stage regression results using both Community Banks definitions

	All banks	
	Model I	Model II
Community Bank_FDIC	0.002***	0.002***
	(0.001)	(0.001)
Community Bank_Size	0.435***	0.477***
	(0.036)	(0.039)
Total Assets (ln)	0.009***	0.009***
	(0.001)	(0.001)
Deposit / Assets	-0.137***	-0.124***
	(0.006)	(0.006)
Credit risk	-0.012***	-0.011***
	(0.001)	(0.001)
Loan Loss Allowance / Loans	-0.426***	-0.233***
	(0.058)	(0.061)
Equity / Assets	-0.323***	-0.282***
	(0.034)	(0.036)
Liquidity risk	0.017***	0.007**
	(0.003)	(0.003)
ROE	-0.006	0.003
	(0.019)	(0.020)
z-score (ln)	-0.001	0.001
	(0.001)	(0.001)
Cost / Income	-0.089***	-0.082***
	(0.029)	(0.030)
Bank Holding Company	-0.013***	-0.014***
	(0.003)	(0.003)
Liquidity Creation	0.018***	0.025***
	(0.006)	(0.007)
Construction & Development Loans	-0.031***	-0.038***
	(0.011)	(0.012)
Agricultural Loans	-0.160***	-0.170***
	(0.028)	(0.032)
Commercial Real Estate Loans	0.127***	0.130***
	(0.007)	(0.007)
Commercial & Industrial Loans	0.196***	0.190***
	(0.010)	(0.011)
Residential Mortgages Loans	-0.121***	-0.108***
	(0.008)	(0.008)
Loans to Individuals	-0.058***	-0.056***
	(0.007)	(0.007)
Crisis		-0.001**
		(0.001)
Policy Uncertainty Index (ln)		0.001***
		(0.001)
Real GDP Growth		0.001
		(0.001)
Inflation		0.003***
		(0.001)
Total Assets (ln) × CB	-0.038***	-0.039***
	(0.001)	(0.001)
Deposit / Assets × CB	0.028***	0.018***
	(0.006)	(0.006)

Credit risk × CB	0.006***	0.006***
	(0.001)	(0.001)
Loan Loss Allowance / Loans × CB	0.127**	-0.027
	(0.060)	(0.064)
Equity / Assets × CB	0.357***	0.315***
	(0.034)	(0.037)
Liquidity risk × CB	-0.039***	-0.029***
	(0.003)	(0.003)
ROE × CB	0.054**	0.040*
	(0.022)	(0.023)
z-score (ln) × CB	0.001	0.001
	(0.001)	(0.001)
Cost / Income × CB	0.063**	0.055
	(0.031)	(0.034)
Bank Holding Company × CB	0.009***	0.011***
	(0.003)	(0.003)
Liquidity Creation × CB	-0.042***	-0.046***
	(0.006)	(0.007)
Real GDP Growth × CB		-0.001
		(0.001)
Inflation × CB		-0.003***
		(0.001)
Construction & Development Loans × CB	0.039***	0.050***
	(0.011)	(0.012)
Agricultural Loans × CB	0.319***	0.325***
	(0.028)	(0.033)
Commercial Real Estate Loans × CB	-0.035***	-0.042***
	(0.007)	(0.008)
Commercial & Industrial Loans × CB	-0.099***	-0.097***
	(0.010)	(0.011)
Residential Mortgages Loans × CB	0.080***	0.073***
	(0.008)	(0.008)
Loans to Individuals × CB	0.060***	0.055***
	(0.007)	(0.007)
Constant	0.717***	0.668***
	(0.032)	(0.033)
State Fixed Effects	YES	YES
Year Fixed Effects	YES	YES
Pseudo R2	0.232	0.239
Log Pseudolikelihood	1,785,787	1,668,757
Observations	941,179	865,030

NOTES: The table presents second-stage regression results for the overall efficiency score. Model I includes only bank- specific variables and Model II includes both bank- specific and macroeconomic variables. The dependent variable is the Overall Efficiency score. Community Bank_FDIC denotes the dummy created based on the FDIC definition whereas Community Bank_Size denotes the dummy created based on only size criterion. Variables are interacted with the Community Bank_Size dummy here. The credit and liquidity risk proxies are calculated following Imbierowicz & Rauch (2014), see section 4.2 for more details. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). All loan categories are expressed as a ratio to total assets. At each regression state and year fixed effects are included but not reported for brevity. Robust standard errors clustered at the bank level are reported in brackets. ***, **, * denote statistical significance at the 1, 5 and 10% level respectively.

Appendix 3.2

Basic cost efficiency analysis

A stylized cost frontier model is the following

$$lnC^{a} = lnC^{*}(w, y) + \eta + \nu \quad (1)$$

$$= lnC^{*}(w, y) + \epsilon \quad (2)$$

$$\eta \sim N^{+}(0, \sigma_u^2), \quad (3)$$

$$\nu \sim N(0, \sigma_\nu^2), \quad (4)$$

Where $\epsilon \equiv \nu + \eta$ is the composed error of the model (subscript i is omitted).

The log-likelihood function for observation i is

$$L = -\ln\left(\frac{1}{2}\right) - \frac{1}{2}\ln(\sigma_\nu^2 + \sigma_u^2) + ln\phi\left(\frac{-\epsilon}{\sqrt{\sigma_\nu^2 + \sigma_u^2}}\right) + ln\Phi\left(\frac{\mu_*}{\sigma_*}\right) \quad (5)$$

Where

$$\mu_* = \frac{\sigma_u^2 \epsilon}{\sigma_\nu^2 + \sigma_u^2} \quad (6)$$

$$\sigma_* = \frac{\sigma_\nu^2 \sigma_u^2}{\sigma_\nu^2 + \sigma_u^2} \quad (7)$$

The sum of this function for all observations is the log-likelihood function of the model. Maximizing the log-likelihood function gives the ML estimates of model parameters.

Appendix 3.3

k-means nearest neighbour matching

The k-means nearest neighbor matching relies on some distance function to quantify the closeness between two (or more) observations. In our context, for each observation of a community bank, the k-means nearest neighbor approach determines the "nearest" observation of a non-community. To define the closeness of the observations, a distance function is used. In the general form we can denote this variable as x. Then the distance between two observations i, j is given as:

$$|x_i - x_j| = \frac{(x_i - x_j)(x_i - x_j)}{Cov(x, x)} \tag{1}$$

We can generalize this formula for when we have p number of covariates using matrix algebra. Assume that $x = \{x_1, x_2, \dots, x_p\}$ and that each observation, i, has the following set of covariates $\mathbf{x}_i = \{x_{1,i}, x_{2,i}, \dots, x_{p,i}\}$. The distance between observations i, j is now given as:

$$\|\mathbf{x}_i - \mathbf{x}_j\| = \left((\mathbf{x}_i - \mathbf{x}_j)'\mathbf{S}^{-1}(\mathbf{x}_i - \mathbf{x}_j)\right)^{1/2} \tag{2}$$

where $\mathbf{S}$ is the variance-covariance matrix of the covariates. Typical choices for $\boldsymbol{S}$ are:

$$\mathbf{S} = \begin{cases} \mathbf{I}_{\boldsymbol{p}} & \text{for the Euclidean case} \\ \dfrac{(\mathbf{X} - \bar{\mathbf{x}}'\mathbf{1}_{\boldsymbol{n}})'\boldsymbol{W}(\mathbf{X} - \bar{\mathbf{x}}'\mathbf{1}_{\boldsymbol{n}})}{\sum_i^n w_i - 1} & \text{for the Mahalanobis case} \end{cases} \tag{3}$$

where $\mathbf{1}_{\boldsymbol{n}}$ is an $n \times 1$ vector of ones, $\mathbf{I}_{\boldsymbol{p}}$ is the identity matrix of order p, same as the number of covariates used. w_i is the frequency weight for the i observation, $\bar{\mathrm{x}} = \sum_i^n w_i \, \mathrm{x}_i / \sum_i^n w_i$ which denotes a weighted mean and $\mathbf{W}$ is an $n \times n$ diagonal matrix containing the frequency weights. Compared to the Euclidean case, the Mahalanobis is preferred as it accounts for interactions between the covariates. We can define the following set of nearest-neighbor index for observation i:

$$\Omega(i)^x = \{j | t_j = 1 - t_i, \|\mathbf{x}_i - \mathbf{x}_j\| < \|\mathbf{x}_i - \mathbf{x}_l\|_{\mathbf{S}}, t_l = 1 - t_i \forall l \neq j\} \tag{4}$$

where i is the observation corresponding to a community bank and for which we want to find a matching non-community. j denotes the matching non-community (is only one in this case) and l denotes another candidate non-community. t denotes the treatment effect and takes the value 1 for community banks, zero otherwise. $\|\mathbf{x}_i - \mathbf{x}_j\|$ and $\|\mathbf{x}_i - \mathbf{x}_l\|$ denote the distance between i, j and i, l respectively and in the formula above we require that the distance between i, j is smaller than i, l ; hence minimized over possible matching candidate observations. The above can be generalized for m matching observations to enhance reliability of the comparisons, as follows:

$$\Omega(i)_m^x = \left\{j_1, j_2, \dots, j_m | t_{j_k} = 1 - t_i, \left\|\mathbf{x}_i - \mathbf{x}_{j_k}\right\|_{\mathbf{S}} < \left\|\mathbf{x}_i - \mathbf{x}_{j_k}\right\|_{\mathbf{S}}, t_l = 1 - t_i \forall l \neq j_k\right\} \tag{5}$$

For the prediction of the potential outcomes we remind the following notation. $y_{1,i}$ is the potential outcome of the i observation that corresponds to a community bank ($t = 1$). Conversely, $y_{0,i}$ is the potential outcome of the i observation that corresponds to a non-community ($t = 0$). As discussed, only $y_{1,i}$ or $y_{0,i}$ is observed, never both. The k-means nearest neighbors estimates the potential outcome for the i observation as follows:

$$\hat{y}_{t,i} = \begin{cases} y_i \text{ if } t_i = t \quad \text{for } t \in \{0,1\} \\ \dfrac{\sum_{j \in \Omega(i)} w_j y_j}{\sum_{j \in \Omega(i)} w_j} \end{cases} \tag{6}$$

Where the first is the case that the outcome of the individual observation (y_i) is observed whether community ($t = 1$) or non-community ($t = 0$). The second case is the counterfactual outcome, which does not exist and is estimated as the outcome of the closest match (or matches). The following quantities of interest, namely the Average Treatment Effect (ATE) and the Average Treatment Effect on the Treated (ATET) can be defined as:

$$ATE = \tau_1 = E(y_1 - y_0) \tag{7}$$

$$ATET = \delta_1 = E(y_1 - y_0 | t = 1) \tag{8}$$

Chapter 4 - The impact of competition on the capitalisation-stability-efficiency nexus across different bank types; the case of US community banks

4.1 Introduction

Financial markets have become increasingly integrated as a result of deregulation and globalisation. Higher competition is therefore observed as banks offer an increasing number of products, with the once clear boundaries between investment and commercial banking activities becoming blurred. The increasing importance of non-banks provides yet another contender for the same pool of investors/depositors. In this background banks realise that inefficiency may be harshly penalised by their competitors. Likewise, increased competition may induce higher risk-taking as banks try to maintain their established market position, often at the expense of stakeholders and/or taxpayers. As a counterbalance, regulators require banks to have higher capital ratios, and place tighter controls on the market risk and the liquidity risk of banks. However, the exact effect of an increase in banks' capitalisation requirements upon bank risk is not a straightforward one (Jeitschko and Jeung 2005).

A number of studies have focused on the impact of capital (Gropp and Heider 2010), efficiency (Casu and Girardone 2009), business model (Scott and Dunkelberg 2010; Berger et al. 2009) and competition (Schaeck and Cihak 2014) on financial stability. Other studies have recognised the existence of intertemporal relations between several of these variables, most notably the capital-risk-efficiency nexus (Altunbas et al. 2007; Fiordelisi et al. 2011). In a similar context, the triple relation between competition-efficiency-stability is examined in Schaeck and Cihak (2014), Boyd and De Nicolo (2005), De Nicolo and Lucchetta (2009) and Casu and Girardone (2009) suggesting that efficiency is the conduit through which competition contributes to stability. In this context, the role of the business model has received limited attention, see for example De Angelo and Stulz (2015). However, there is no study to date that has jointly investigated the relationship of all five variables in a unified framework. In particular, the ongoing financial consolidation suggests that competition has an important role on banking operations and risk management typically portrayed in the capital-risk-efficiency nexus.[37] Besides, banking systems comprise different types of financial institutions each with its own unique characteristics; thereby challenging the validity of one-size-fits-all regulatory and supervisory policies.[38] This paper aims at filling this gap in the literature.

The business model of US community banks is markedly different from their non-community counterparts. We distinguish community banks based on the FDIC (2012) definition that goes beyond the single size criterion, that has been previously used in US literature in order to define this bank type (see for example Feng and Zhang 2012; Bonilla et al. 2018; Chiorazzo et al. 2018), and captures differences associated with the geographic scope of operations, the access to capital markets, too big to fail subsidies, lending opportunities and lending technology. Thus, this definition expands to an array of business model criteria that can drive differences in research outcomes. Community banks are traditional deposit-taking/loan-making financial institutions that abstain from complex financial derivative structures and other exotic investments and focus their operations to the real economy. They are, perhaps, most known for being proponents of "relationship lending" practices. In contrast to hard information, soft information is neither easily quantifiable nor collected. Community bankers have an intimate knowledge of the local community that gives them detailed, soft information on particular aspects of their customers, such as managerial skill and reputation. Competition is listed among the top challenges that community banks face impacting them in their ability to attract deposits and generate loans as well as diluting their business focus (CSBS Study, 2019). First, competition impedes the ability of community banks to attract deposits; their main financing tool. In securing core deposits, community banks are particularly vulnerable to competition from other institutions with a physical presence, due to the traditional profile of their clientele that ranks proximity higher than technological innovations and/or remuneration. Competition from online financial institutions (e.g., microbanks) is bound to increase as depopulation and population aging change the profile of the bank users. Besides, the use of alternatives to core

[37] Competition is known to affect stability (see section 4.2.2.1 below for a detailed review), while competition measures that belong to the efficient structure hypothesis (e.g., Lerner index, Boone indicator) link performance to competition at the bank level; thus necessitating the use of a unified framework to account for endogeneity.
[38] A plethora of banking models may be operating within country, with marked differences between them and a differentiated regulatory touch. Besides the distinction between community and non-community (commercial) banks in the US that we examine here; building societies in the UK, co-operative banks in Germany, Islamic banks in the Middle and Far East have distinctive business model from the commercial banks that operate alongside to, which may require a customised approach from regulatory and supervisory authorities (see for example BRSS 2017).

deposits (e.g., wholesale funds) is confined to the larger of community banks, typically due to their riskier nature and a "stigma" attached to their use, plausibly related to the fact that they may be contradictory to the relationship approach. Second, competition erodes the loan generating business of community banks; effectively constraining them into business lines where proximity and relationships matter the most, such as agricultural, real estate and small business loans. Increases in compliance costs (e.g., current expected credit loss - CECL) place additional challenges and disadvantage these banks compared to the technologically more capable institutions. Third, competition forces community banks to use products and services that are beyond their technological capabilities; thus effectively diluting their business model. For example, the primary driver in adopting online banking and technology, such as online loans and remote deposits, is to match the competition rather enhancing bank profitability and/or stability, and despite the lack of in-house expertise for such offerings. In addition, community banks consider M&A activity for reasons not related to their business model, but to fence off competition through achieving increased technological capabilities. Based on the distinct business model of community banks we derive empirically testable questions to investigate the relationships between capital, risk, efficiency, competition and business model.

Against this background we motivate our paper. First, we provide comprehensive evidence on whether the alternative banking model practiced by the US community banks exhibits a distinct financial profile – in terms of capitalisation, financial stability, efficiency and market power– compared to the non-community banks. We delve deeper and explore the bank- specific and macroeconomic factors that drive these differences in the financial profile of the two bank types. In particular we investigate if the links between capitalisation, financial stability, efficiency and market power and the related hypotheses[39] suggest further differentiation in the banking models practiced by the two bank types. Second, we examine the extent to which the unique business model of community banks acts as a protection layer for their financial profile that could curtail potential threats from competitive pressure. Third, taking the converse viewpoint we present novel evidence on the determinants of banking competition and whether it is primarily driven by the small-and-numerous community banks or the large-and-few non-community banks. Fourth, we conduct follow-up analysis to explore the underlying benefits

[39] In line with the banking literature we test the hypotheses of "bad luck", "bad management", "cost skimping", "moral hazard" and "regulatory hypothesis" (Berger and DeYoung 1997), the "franchise value" (Keeley 1990) and "risk-shifting" paradigm (Boyd and De Nicolo 2005), the "quiet life" hypothesis (Berger and Hannan 1998), the "efficient structure hypothesis" (Demsetz 1973) and the "information generating hypothesis" (Marquez 2002)

that the traditional banking approach could bring to the non-community banks' financial profile, and the specific channels through which it materialises. Furthermore, we seek to identify any limitations of the traditional banking approach upon the financial profile of community banks.

Our empirical findings document that after controlling for bank- specific and macroeconomic factors commonly present in other banking studies, community banks have higher capitalisation ratios, superior cost efficiency, greater financial stability and higher market power than their non-community counterparts. Furthermore, we verify a positive relationship between stability and capitalization for both bank types in accordance with the "moral hazard hypothesis". Banks with lower levels of risk need less capital to compensate for potential losses from their loan portfolio, while banks that are better capitalised have lower probability of default. We also find a positive relationship between capitalisation and cost efficiency. Efficient banks utilise their resources better and achieve high earnings without the need to take on excessive risks and/or push capitalisation buffers to the limit. Additionally, we document a negative relationship between efficiency and stability, typically evidence of risky, cost skimping practices, albeit only for the non-community banks. Competition affects the financial profile of banks in a complex way. Among the non-community banks, we find strong support for the "competition-fragility" hypothesis. The evidence is more muted for the community banks, where their relationship-based approach and loan due diligence process are robust to competitive pressure. The fragility of the non-community banks is further aggravated by the lower – around 22 times – marginal effect of competition compared to the community banks that affects their capitalisation. The higher marginal effect of capitalisation on financial stability for community banks is supportive of the smoother regulatory touch for this bank type. We find support for the "information generating hypothesis" (Marquez 2002) as higher market power increases the efficiency of banks. The community banks reap the most benefits as their business model emphasizes on unique loan-level and/or bank-level characteristics; thus giving them information monopoly. With regards to the drivers of market power at the bank level, we find stability to be the key determinant, with a positive link for both bank types. In addition, market power is increased through higher efficiency in the case of non-community banks, and higher liquidity creation in the case of community banks. Finally, we find that a shift towards a traditional banking approach in the non-community banks can increase their stability, efficiency and market power. This is largely manifested through the channels of relationship lending and branch networks, whereby the former can bring significant benefits in both stability and efficiency, and the latter is associated with increased market power. The traditional banking approach is not panacea, as evidenced by its quadratic relationship (U-shaped or inverse U-shaped) to each of capitalisation, stability, efficiency and market power. However, the majority of the community banks experience the positive side of this relationship.

We contribute to the banking literature in three ways. This is the first study to introduce an important fourth factor in the capital-efficiency-stability nexus that has long been precluded - competition. Amidst financial consolidation, globalisation and market deregulation; competition has been at the epicentre of banking research, see for example Allen et al. (2011), Martinez-Miera and Repullo (2010) and Keeley (1990) and references therein documenting the convoluted effect of competition on bank stability and how it has shifted through the years. Second, by introducing banking model dynamics in the above framework we provide novel results about how an alternative banking model (community banks) fares against its competitors. Community banks are renowned for their traditional banking model and relationship banking approach, but whether this manifests advantages (or disadvantages) upon their financial profile has been previously unexplored. In a related context, Islamic banks[40] command increased customer loyalty and enjoy lower credit risk (Beck et al. 2019; Abedifar et al. 2013). Third, and to the best of our knowledge, this study is the first to quantify the benefits and limitations of the traditional banking model to non-community and community banks respectively. To do so, we go further than the extant binary classification of community banks, and gauge the exact channels through which the traditional banking model operates (i.e., relationship lending, deposit funding, traditional income and branch coverage), which are used to construct a continuous variable measuring the intensity of traditional banking activities at the bank-level.

The remainder of the chapter is organised as follows. Section 4.2 discusses the relevant literature. Section 4.3 presents the methodology used in this study. In section 4.4 we describe the data. We present and discuss the results in section 4.5. Finally, section 4.6 summarises and concludes.

[40] Islamic banks are a type of an alternative banking model largely practiced in the Middle and Far-East. Like community banks, Islamic banks are also proponents of the relationship banking approach.

4.2 Theoretical background

4.2.1 The capital-risk-efficiency nexus

A number of studies have focused on the impact of capital (Gropp and Heider 2010), efficiency (Casu and Girardone 2009), business model (Scott and Dunkelberg 2010) and competition (Schaeck and Cihak 2014) on bank risk. Several studies have recognised the existence of intertemporal relationships between subsets of these variables, most notably the capital-risk-efficiency nexus. Berger and DeYoung (1997) use Granger-causality techniques to test four hypotheses regarding the relationships between bad loans, cost efficiency and capitalization for US commercial banks from 1985 to 1994. They refer to these hypotheses as the "bad luck", "bad management", "skimping" and "moral hazard" hypotheses. Their findings show that relationships between bad loans and cost efficiency run in both directions. The "bad luck" hypothesis assumes that exogenous events affect the performance of bank's investments. Therefore, an increase in non-performing loans would bring additional costs to deal with these loans and would translate to a decrease in cost efficiency. As such, an increase in bank risk may precede a decline in efficiency. The "bad management" hypothesis implies that poor senior management quality would lead to low levels of cost efficiency. It is argued that inefficient banks would have higher costs related to operating expenses and/or monitoring of its investments, hence bank risk would be higher. As such, declines in efficiency are likely to precede rises of bank risk. Under the "cost skimping" hypothesis, the bank managers are willing to exploit the lag in the relationship between efficiency and risk. Managers reduce short-term operating costs associated with underwriting and monitoring loans which makes the bank appear to be more cost efficient in the short run because lower operating expenses support the same quantity of outputs. However, as time passes, deterioration in the loan portfolio becomes apparent. The "moral hazard" hypothesis posits that managers of thinly capitalized banks are more likely to take on higher risks, reflective perhaps of the lower shareholder engagement in the bank management. By contrast, when capitalization is high, such moral hazard problems are reduced since shareholders are more actively involved in the bank's operations (Fiordelisi et al. 2011). The Basel Accord attempts to control bank risk through capital adequacy requirements. The framework that governs the capitalization levels of banks is built on the premise of risk-weighted assets. The intended effect that higher capitalization will limit bank's risk-taking behaviour is described through the "regulatory" hypothesis. This hypothesis supports a positive relationship between capitalization and bank risk, which is plausible since regulators require banks to increase their capital in proportion to the risk taken.

Kwan and Eisenbeis (1997) employ a simultaneous equation framework to examine the interrelationships between risk, capitalization and efficiency for US banking organizations during the period 1986 to 1995. They find that declines in efficiency precede rises of risk – both credit and interest rate risk and capital. This offers support for the "bad management" hypothesis, whereas the negative effect of efficiency on capital is attributed to pressure from the regulators for inefficient banks to hold more capital. Their results also show a positive relationship between capital and efficiency. Hughes and Mester (1998) find evidence that US bank managers are risk averse and they use capital level to signal risk. At any level of bank performance, they increase capital to control for risk management. Altunbas et al. (2007) do not find a strong relationship between efficiency and risk-taking for European banks during the period 1992 to 2000, which contradicts the evidence from the US literature. Their results suggest that less efficient banks hold higher levels of capital and take on less risk. They also find a positive relationship between risk and capital, in support of the "regulatory hypothesis". Fiordelisi et al. (2011) employ Granger-causality methods to assess the intertemporal relationships between capital, risk and efficiency for a sample of European commercial banks from 1995 to 2007. Their results show a bi-directional relationship between efficiency and risk which confirms the "bad management" hypothesis. They also show that higher bank capital leads to improvements in cost efficiency, suggesting that better capitalized banks are more likely to reduce their costs. They also find that banks that are more efficient become better capitalized and that higher capital positively affects efficiency. Little evidence is found for the "moral hazard" hypothesis between capital and risk and is mostly driven by accounting-based and not market-based risk proxies. In the Chinese banking, Tan and Floros (2013) find a positive relationship between (credit) risk and efficiency and a negative between (insolvency) risk and capitalization.

4.2.2 The role of competition

4.2.2.1 The link between competition and risk

The trade-off between bank competition and stability has been a controversial issue among policy makers and academic circles alike, particularly since the Global Financial Crisis (GFC) of 2007 (Berger et al. 2004; Martinez-Miera and Repullo 2010; Wagner 2009). Two competitive views have emerged in the banking research on the relationship between competition and stability. Under the “franchise value” paradigm, which was proposed by Keeley (1990), increased competition can erode the franchise value of banks thus forcing them to pursue riskier policies, leading to financial fragility. On the other hand, the “risk-shifting” paradigm argues that excessive competition could lower loan rates, thus decrease borrower’s credit risk and promote financial stability (Boyd and De Nicolo 2005). The “competition - stability/fragility” nexus has been a debated issue in the banking literature. Martinez-Miera and Repullo, (2010) combine these opposite views and show that there exists a U-shaped relationship between bank competition and stability. In their model increased competition reduces the borrower’s probability of default when loan rates decrease (risk-shifting effect). However, there also exists a “margin effect” that decreases interest payments from bank’s performing loans. Hence, the risk first decreases and then increases as competition increases.

Empirical research investigates this competition-stability/fragility nexus in different economies and the results are best described as mixed. Empirical results from Keeley (1990) suggest that increased competition brought by relaxation of interstate banking restrictions in the 1980s caused large US bank holding companies to take on more risk. Boyd et al. (2006) using two large samples, a 2003 cross-sectional sample of US banks and a panel data set from 134 non-industrialized countries for the period 1993-2004, find a negative relationship between competition, as measured by the HHI, and probability of failure, as measured by the Z-score. Their results however are dependent on two different model specifications. The first model (CVH), which allows for competition in the deposit but not in the loan market, predicts a positive relationship between competition and stability. The second model (BDN) implies a negative relationship. Similar theoretical results are obtained by Boyd et al. (2009) suggesting that the relationship between bank competition and stability depends on the model specification and can be reversed by adopting a different specification. Their empirical results, obtained from the same two datasets as per Boyd et al. (2006), show that as the market becomes more competitive, the risk of failure decreases, thus giving support for the “competition stability” doctrine.

Goetz (2018), Goetz et al. (2016) and Jiang et al. (2017) examine how the process of interstate banking deregulation affects competition. Regulatory restrictions in the US prohibited banks from interstate banking for many decades. During the 1980s and 1990s, individual states gradually lifted these restrictions and allowed banks to expand across states and compete with local banks. Finally, the Riegle-Neal Act (1994) removed all remaining barriers to interstate banking and branching. The removal of entry barriers fostered competition across banks. Interstate banking deregulation allowed banks to enjoy benefits of geographic diversification. That geographic expansion lowers Bank Holding Companies' risk, by enabling banks to diversify their exposure to idiosyncratic local market risks (Goetz et al. 2016). Jiang et al. (2017) find empirical evidence for the "competition fragility" paradigm for the US banks over the 1980s and 1990s. Competition reduces bank profits and bank charter values, increases the provision of non-traditional banking products and decreases relationship lending. The findings of Goetz (2018) suggest that removal of interstate banking restrictions is associated with an increase in bank stability. Because removing entry barriers fosters competition, their finding supports the "competition-stability" doctrine.

Empirical evidence on the relationship between regulation, competition and stability in the EU is ambiguous as well. National regulations, such as restriction on activities, capital requirements and supervisory power, shape the risk-taking behaviour of banks and this is channelled through the market power possessed by banks (Agoraki et al. 2011). Empirical results from their study suggest that banks with more market power have a lower probability of default. Uhde and Heimeshoff (2009) find evidence consistent with the "competition-stability" view across the EU-25 over the period 1997 to 2005 and suggest that national banking market concentration has a negative impact on bank's stability as measured by the Z-score. A more recent study by Leroy and Lucotte (2017) find evidence in line with the "competition-fragility" doctrine, suggesting that listed European banks, when facing with more competition, take on more risk, thus increase individual bank fragility. Using a global sample, Berger et al. (2009) find support for both the "competition-stability" and "competition-fragility" paradigms. Banks with more market power hold more loan portfolio risk but may bear less overall risk exposure by increasing their equity capital or engage in risk-mitigating activities.

4.2.2.2 The link between competition and efficiency

Competition and efficiency are closely related in banking. The Efficient structure hypothesis (ESH) suggests that more efficient banks survive competitive pressures and acquire market shares, thus efficiency determines market structure (Demsetz 1973).[41] Berger and Hannan (1998) employ a sample of US banks from 1980 to 1989 and find evidence that the "quiet life"

[41] Market structure hypothesis suggests reverse causality between efficiency and market structure.

hypothesis prevails in the US banking. The “quiet life” hypothesis posits that banks operating in less competitive markets exhibit lower cost efficiency than banks that are more exposed to competition. This can be because managers do not have the incentives to work as hard or they pursuit objectives other than profit maximization. Hence, under the “quiet life” hypothesis market power determines efficiency. Koetter et al. (2012) use efficiency-adjusted Lerner indices and they find support for the ESH rather than the “quiet life” hypothesis for US bank holding companies for the period 1986 to 2006. Marquez (2002) introduces a model that proposes an adverse direction between competition and efficiency, which is referred in the literature as the “Information Generating Hypothesis” (IGH). In this model, increased competition leads to inefficiency. As competition increases, this creates “information dispersion” among a larger number of small banks. These banks have now less information about the market and thus they are less effective in their screening process. This implies a higher likelihood of adverse selection that leads to bank inefficiencies. Maudos and de Guevara (2007) find a negative relationship between competition and cost efficiency for EU banks over the period 1993 to 2002, thus rejecting the “quiet life hypothesis” of Berger and Hannan (1998).

4.2.2.3 The competition-risk-efficiency nexus

Another strand of literature examines the simultaneous relationship between competition, efficiency and stability. Schaeck and Cihák (2008) find empirical evidence that competition increases bank stability, via the efficiency channel for both a European and US sample. The triple relation between competition-efficiency-risk is again examined in Schaeck and Cihak (2014). Their results indicate that the stability-enhancing effect of competition is greater for healthy banks whereas fragile banks benefit less from competition, suggesting that efficiency is the conduit through which competition, as measured by the Boone indicator, improves stability. In addition, the competition-efficiency-risk nexus in developing economies has been examined in Turk Ariss (2010), with the results indicating that increased competition undermines bank stability and cost efficiency but improves profit efficiency. The theoretical work of De Nicolo and Lucchetta (2009) introduces two models under which more bank competition results in lower economy-wide risk and capital and more efficient production plans.

4.2.3 Business model and hypotheses development

Based on the distinct business model of community banks, we derive empirically testable hypotheses to investigate the relationships between the variables discussed above. Concerning the relationship between risk and efficiency, exogenous factors affect community banks stronger than non-community, since they often do not have the ability to hedge against exogenous events. So, we expect that the "bad luck" hypothesis will get stronger support for this bank group. The personnel of community banks are often skilled, which would lead to higher levels of efficiency, suggesting that the "bad management" hypothesis is less likely to find support. No a priori hypothesis is made for the "cost skimping" hypothesis. In terms of the capital and risk relationship, we suggest that there are lower moral hazard incentives for community banks as they often pursue goals other than profit maximization. This implies lower risk for this bank type due to lower moral hazard. Due to the fact that community banks have more flexible regulation, we cannot make any assumptions on the "regulatory hypothesis".

Community banks compete against other community and non-community banks. Excessive competition from non-community banks could induce community banks to increase risk, as they would be afraid of losing customers and they would not want to break any long-term relationships they have with them (Besanko and Thakor 2010). So, we expect to find evidence of the "franchise value" rather than the "risk-shifting" paradigm. Concerning the relationship between competition and efficiency, we suggest that the "information generating hypothesis" would be more relevant for community banks. As competition increases, the information benefits that community banks derive from their proximity to their customers and the long-term relationship with them, disperse among a larger number of small banks. This leads to more adverse selection and higher inefficiency.

4.3 Methodological framework

4.3.1 Model Specification

The current section discusses the methodology adopted in this paper. We are specifying a system of four equations, one for each variable of interest, namely capitalisation, stability, efficiency and market power. We rely on a three stage least square estimation (3SLS) to investigate the relationships between these variables in line with Tan and Floros (2013). The advantage of this approach is that it takes into account endogeneity and the cross correlation between the error terms. The system of equations is given below:

$$CA_{it} = \alpha_0 + \alpha_1 ST_{it} + \alpha_2 EFF_{it} + \alpha_3 MP_{it} + \alpha_4 Bank_{it} + \alpha_5 Macro_{it} + \beta_0 CB + \beta_1 CB_{it} \times ST_{it} + \beta_2 CB_{it} \times EFF_{it} + \beta_3 CB_{it} \times MP_{it} + \beta_4 CB_{it} \times Bank_{it} + \beta_5 CB_{it} \times Macro_{it} + \varepsilon_{it} \quad (4.1)$$

$$ST_{it} = \gamma_0 + \gamma_1 CA_{it} + \gamma_2 EFF_{it} + \gamma_3 MP_{it} + \gamma_4 Bank_{it} + \gamma_5 Macro_{it} + \delta_0 CB + \delta_1 CB_{it} \times CA_{it} + \delta_2 CB_{it} \times EFF_{it} + \delta_3 CB_{it} \times MP_{it} + \delta_4 CB_{it} \times Bank_{it} + \delta_5 CB_{it} \times Macro_{it} + \varepsilon_{it} \quad (4.2)$$

$$EFF_{it} = \zeta_0 + \zeta_1 CA_{it} + \zeta_2 ST_{it} + \zeta_3 MP_{it} + \zeta_4 Bank_{it} + \zeta_5 Macro_{it} + \theta_0 CB + \theta_1 CB_{it} \times CA_{it} + \theta_2 CB_{it} \times ST_{it} + \theta_3 CB_{it} \times MP_{it} + \theta_4 CB_{it} \times Bank_{it} + \theta_5 CB_{it} \times Macro_{it} + \varepsilon_{it} \quad (4.3)$$

$$MP_{it} = \mu_0 + \mu_1 CA_{it} + \mu_2 ST_{it} + \mu_3 EFF_{it} + \mu_4 Bank_{it} + \mu_5 Macro_{it} + \sigma_0 CB + \sigma_1 CB_{it} \times CA_{it} + \sigma_2 CB_{it} \times ST + \sigma_3 CB_{it} \times EFF_{it} + \sigma_4 CB_{it} \times Bank_{it} + \sigma_5 CB_{it} \times Macro_{it} + \varepsilon_{it} \quad (4.4)$$

Where subscripts *i* and *t* denote banks and quarters respectively. *CA* denotes the capitalisation and is proxied by the ratio of Equity/Assets. *ST* denotes insolvency risk and is proxied by the z-score. *EFF* is cost efficiency and *MP* is market power proxied by the Lerner Index. *CB* is the community bank dummy and takes the value of 1 for a community bank, zero otherwise. $CB_{it} \times CA_{it}$, $CB_{it} \times ST_{it}$, $CB_{it} \times EFF_{it}$ and $CB_{it} \times MP_{it}$ are the interactions between the community bank dummy and the four endogenous variables (i.e. capitalisation, stability, efficiency and market power) respectively. *Bank* and *Macro* are the exogenous, bank-specific and macroeconomic factors influencing the capitalisation, stability, efficiency, market power relationship. $CB_{it} \times Bank_{it}$ and $CB_{it} \times Macro_{it}$ are the interactions between the community bank dummy and bank- specific and macroeconomic control variables respectively and ε_{it} is the random error term.

4.3.2 Endogenous Variables

Capitalisation is calculated as the ratio of Equity over Total Assets, with higher values denoting a more capitalised bank. To proxy for *financial stability* we employ the z-score, a commonly used measure in the banking literature, see for example (Imbierowicz and Rauch 2014; Laeven and Levine 2009). The z-score calculates the number of standard deviations that the bank's return on assets must fall below its mean to deplete equity as a percentage of assets. Higher profitability and capitalisation increase the z-score whereas more earnings volatility decreases it. Therefore, higher values of the z-score indicate more financially stable banks. To construct the z-score we follow Cihák and Hesse (2007) where the z-score considers only the last period value for the equity/assets and the ROA, while it computes $\sigma(ROA_T)$ over the whole sample period.[42] We construct the z-score as follows:

$$Z - score_t = \frac{\frac{Equity_t}{Assets_t} + ROA_t}{\sigma(ROA_T)} \tag{4.5}$$

We use the natural logarithm transformation as the z-score features high skewness.

We use a Stochastic Frontier Approach (SFA) to obtain estimates of *cost efficiency*, following the Kumbhakar et al. (2014) model.[43] Stochastic Frontier Analysis is particularly well suited to deal with panel data and allows for stochastic errors. The Kumbhakar et al., (2014) model decomposes the unobserved fixed effects from the persistent efficiency, while maintaining the residual efficiency component of the earlier models. This essentially allows for a persistent component of efficiency that affects all banks in the sample, while another component (i.e., residual efficiency) identifies deficiencies in specific banks. As such the persistent efficiency component is associated with factors that are relatively constant over short time spans, such as structural inflexibilities or regulatory restrictions. The residual component reflects the usual managerial efficiency. However, it allows a bank's efficiency to adjust over time as the bank may eradicate some of the short-term rigidities. Bank heterogeneity, which could be due to different business models and practices, is captured by the firm effects. To proxy for *market power* we use the Lerner Index following Beck et al. (2013). Lerner is a market power indicator that varies at the bank level. It captures the impact of pricing power on the asset and funding side of the bank and, in contrast to other market share proxies, it does not need to define a geographical market for the bank. We construct the Lerner Index for each bank and each year as follows:

$$Lerner_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \tag{4.6}$$

[42] Mare et al. (2016) provide a comprehensive review of several alternative definitions of the z-score.
[43] Details on this approach are given in the Appendix 4.1.

Where P_{it} is the ratio of total interest income to total loans. We assume that the bank produces one output, loans. We believe this is more appropriate for our case since community banks are more concentrated in loan generating activities. We derive marginal cost MC_{it} from a translog cost function (explained in the Appendix 4.2).

4.3.3 Exogenous Variables

The bank-level control variables included are size, liquidity risk, credit risk, profitability, liquidity creation and loan concentration. Size is proxied by the natural logarithm of total assets. To proxy for liquidity risk and credit risk we use the respective measures of Imbierowicz and Rauch (2014). The intuition behind this proxy is that in case of sudden liquidity withdrawals from the bank, the full volume of liabilities may not be liquidated at short notice and/or without substantial cost. Hence the liquidity risk ratio subtracts the volume of all assets that the bank can at short-time and low-cost turn into cash from the volume of liabilities that can be withdrawn from the bank on short notice. It takes into account the bank's exposure to the interbank lending market and derivatives market as well as off-balance sheet liquidity risk positions through, for example, unused loan commitments. The ratio is standardised by total assets with higher values of the liquidity risk ratio indicating a bank that is in worse situation to meet unexpected liquidity demand. Values above zero imply that the bank is not able to endure a sudden bank run, ceteris paribus.

The credit risk proxy measures the unexpected loan default ratio of the bank and is calculated by dividing the average net loan losses (loan charge-offs minus loan recoveries) in the current year by the average loan loss allowance in the previous year. This measure captures the current riskiness of a bank's loan portfolio and the ability of the bank's risk management to anticipate near-term future loan losses. High values of the credit risk ratio suggest high credit risk for the particular bank.[44]

Profitability is proxied by the return on assets (ROA). To account for liquidity creation we use the "catfat" measure of liquidity creation, as developed by Berger and Bouwman (2009). This measure classifies assets based on their liquidity attributes and includes off-balance sheet activities in its calculation. Loan concentration is measured by the Hirschman-Herfindahl index. It is calculated by adding the loan shares of each loan category (e.g., agriculture,

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[44] Appendix 4.3 summarises the formulas for liquidity and credit risk proxies.

commercial….) that a bank is administering to total loans. Higher values of the Loan HHI indicate a more concentrated loan portfolio.

As macroeconomic factors we include the following: i) the quarterly real *GDP growth* and ii) the quarterly *inflation rate* to capture the general economic conditions; iii) the *Federal Funds rate* i.e. the interest rate at which depository institutions with surplus balances in their accounts lend federal funds to other banks that need to quickly raise liquidity overnight; iv) the quarterly change in the *Coincident Economic Activity Index* that captures the change in the condition of the economy, and is calculated from four indicators, the nonfarm payroll employment, unemployment rate, average hours worked in manufacturing and wages and salaries; the unemployment rate; v) *the spread between the 10-year and the 2-year treasury bond rate* calculated as the spread between 10-year treasury constant maturity and 2-year treasury constant maturity; vi) and the *Financial Stress Index* which measures the degree of financial stress in the market and is constructed from 18 weekly data series: seven interest rate series, six yield spreads and five other indicators. Each of these variables capture unique aspect of financial stress. Zero value for this index represents normal financial market conditions, values below zero suggest below-average financial market stress and values above zero suggest above-average financial stress.[45]

4.4 Data

In this section we describe the dataset used in this study. We use quarterly data for the 2001Q1 - 2015Q4 period, extracted from the Call Reports of US banks. For the community bank specialisation we rely on the FDIC definition, obtained from the respective website and we match it to the Call Reports data using the FDIC certificate number which uniquely identifies every bank in our sample. We present key descriptive statistics for the endogenous variables related to our research hypotheses as well as the bank-specific, macroeconomic and market structure exogenous control variables. Bank- specific variables have been trimmed at 1% and 99%. Our final dataset is an unbalanced panel that consists of 11,266 banks and around half

[45] Macroeconomic data are retrieved from the Federal Reserve Bank of St. Louis.

million bank-quarter observations. Of these observations more than 433,000 refer to community banks and around 43,000 to non-community banks.

Table 4.1 presents descriptive statistics for the endogenous variables used in the analysis for the sample of all banks, community banks and non-community banks. Capitalisation of community banks is lower on average than their non-community counterparts (0.112 versus 0.138). Community banks have higher stability, suggesting that they face lower insolvency risk (3.156 versus 2.944). In terms of cost efficiency and market power, community banks appear to outperform, on average, their counterparts (0.804 versus 0.762 and 0.696 versus 0.652 respectively).

[Table 4.1 here]

Table 4.2 and Figure 4.1 present the time evolution of key descriptive statistics relating to capitalisation, stability, efficiency and market power of the two bank types for the full sample on a yearly basis. Across the sample period capitalisation for non-community banks is consistently higher, with the difference between the two bank groups being less pronounced around the GFC period of 2008-2010 (Panel A). Across all the years community banks exhibit superior stability compared to the non-community counterparts by around 0.21 (Panel B), while they appear to be minimally affected by the GFC. The cost efficiency of community banks is consistently higher than that of the non-community banks ranging between 0.804 and 0.802 across all years, the highest being in 2008 and the lowest in 2016 (Panel C). When it comes to market power, up until the years of the GFC the two groups perform closely to each other with community banks maintaining a slightly higher level of market power. However, following the GFC, the two bank groups move in opposite ways. Market power of non-community banks shows a markedly dip while community banks appear to be strengthening their position (Panel D). During the pre- crisis period community banks' average market power stands at 0.690 but in the years after the crisis it increases to 0.712. For non-community banks market power stands on average at 0.669 before the crisis but it plunges at 0.591 in the subsequent years. It appears that non-community banks took a hit in terms of market power after the GFC, whereas the banking model of community banks made them more resilient to adverse pressure from competition.

[Table 4.2 here]

[Figure 4.1 here]

Table 4.3 presents descriptive statistics for capitalisation, stability, efficiency and market power in each state and table 4.4 ranks the states based on the mean value of each variable across the full sample period. A cursory inspection of these statistics shows important differences across the states in terms of capitalisation, with a 6.2pp difference between the highest (DE) and lowest (VT) states; stability, with VT (highest) exhibiting around three times higher financial stability than NV (lowest); efficiency, with an observed gap of 7pp between the most and least efficient states – Nebraska (NE) and Delaware (DE) respectively; market power, where banks in Hawaii (HI) are around 25% less competitive than those in RI. The interrelation among capitalisation, financial stability, efficiency and market power is also evident by the relative ranks of the states in these measures. In particular, Delaware (DE), Arizona (AZ) and Utah (UT) rank among the better capitalised states and among the lowest in stability. Alaska (AK) ranks high in terms of stability but very low in terms of efficiency and market power. Nebraska (NE) is one of the highest states in both efficiency and market power. Hawaii (HI) ranks first in terms of market power but is one of the states with the lowest overall stability.

[Table 4.3 and Table 4.4 here]

The low stability and efficiency scores for Delaware is an interesting observation. Delaware accounts for more than 50% of all public firms (Daines, 2001). Yet, is home to only around 0.30% of the total US population, and contributes 0.40% of the US GDP. Delaware has one of the lowest shares of community banks in the US (below 39% in 2018). Community banks are very few here because the majority of the firms are large, and in need of more sophisticated financial products; yet the handful of banks operating therein have a significantly above average loans/assets ratio and a significantly below average security/assets ratio (see Table 4.5). This could be suggestive that non-community banks incorporated there do not play in home ground; they operate largely in loans yet they lack the relationship banking approach and the expertise of community banks. Conversely their securities operations fall short of their non-community bank peers across the rest of the US states. At the same time, the prices of all input variables are significantly inflated compared to the rest of the US suggesting that Delaware's banks absorb more resources in the process of creating more loans but yet fewer securities. With respect to stability, the lower z-scores for banks incorporated in Delaware are driven by higher volatility of ROA. Post 1998 bank' earnings have been constant for the US in general but rather volatile for Delaware (Figure 4.2). North Dakota, Idaho and New Hampshire are states comparable to Delaware in terms of population and GDP share. However, these states are at the other end of the spectrum in regard to community banking share as they are served exclusively by community banks. The higher stability and efficiency scores of these states compared to Delaware underlines the competitive advantage that community banks get from playing in their own field (Table 4.6).

[Table 4.5 and Table 4.6 around here]

[Figure 4.2 around here]

The dynamics of capitalisation, stability, efficiency and market power at the state level are also insightful. Table 4.7 reports mean values in 2001, in 2015 as well as the percentage change of each of these measures at the state-level. In 80% of the states the average capitalisation has increased, with Rhode Island (RI) and New Hampshire (NH) the two states with the highest percentage change – 104.43% and 65.34% respectively. Despite the capitalisation increase, financial stability decreased in the majority of the states with the biggest decline documented at the state of Delaware (DE) – at around 22.26%, while the state of Vermont (VT) reported a much smaller increase of around 2.26%. Marked increases in efficiency are documented for the majority of the states, with the largest and smallest change of 5.39% and -1.03% for the states of Rhode Island (RI) and South Carolina (SC) respectively. During the study period the US banking system has turned less competitive at the state level, with banks increasing their market power in 46 out of the 50 states. The largest increase in market power is reported in Nevada (NV) around 17.90%, while Hawaii (HI) is one of the few states that market power dropped – at around 17.21%.

[Table 4.7 here]

Table 4.8 summarizes the main descriptive statistics for the explanatory variables used in the 3SLS analysis for the full sample (Panel A), community banks (Panel B) and non-community banks (Panel C). The average value of bank assets (in natural logs) is 11.753 for the community banks and 13.638 for the non-community indicating that there is a significant size advantage for the non-community banks, as we expected. With respect to profitability, the mean value of ROA is significantly higher for the non-community banks compared to the community (6% against 5% respectively). In addition, liquidity risk is higher in community banks compared to the non-community (0.175 against 0.125 respectively), which may be plausible due to the fact that the community banks have limited access to money markets to attract funding in case of emergency. Community banks have significantly lower credit risk compared to the non-community banks (0.152 against 0.256 respectively). The loan concentration is significantly higher for community banks, which may be reflective to the traditional banking business of deposit-taking/loan-making that these banks engage into. Non-community banks appear to create more liquidity than their community counterparts (0.486 versus 0.301).

[Table 4.8 here]

4.5 Empirical Results

Table 4.9 presents estimated coefficients and robust standard errors in parenthesis from the three-stage least square estimation of the system of equations described in the previous section. Equation I presents the estimates for the capitalisation equation. Equation II shows the estimates of the stability equation that uses the z-score. For the cost efficiency equation, the results are represented in equation III and equation IV presents the estimates related to market power. All four equations contain the community bank dummy variable, interactions of the community bank dummy with the endogenous variables and interactions of the community bank dummy with explanatory bank- specific and macroeconomic variables.

[Table 4.9 here]

4.5.1 Results on Capital

Results from estimates of equation I report higher capitalisation for community banks, as evident by the positive coefficient of the community bank dummy. Essentially all banks are subject to regulatory capital requirements; community banks though, appear to be more affected by adverse shocks and for this reason they hold higher capital buffers to confront times of distress. Moreover, community banks have fewer opportunities to diversify and withhold higher capital levels for extra security. Stability and capitalisation are positively linked[46], whereby capital works as a cushion to compensate for losses and banks operating at lower risk levels need lower capitalisation. Although the direction of this effect is the same for both bank groups, the magnitude of the effect is more pronounced for non-community banks. Our results indicate a positive link between cost efficiency and capitalisation, which may reflect the fact

[46] The positive relation between stability and capitalisation is in line with the findings of Tan and Floros (2013) for Chinese banks and Altunbas et al. (2007) for European banks; however these studies do not account for bank type differences.

that more efficient banks have higher earnings, and this causes increases in capital. The magnitude of the effect is about 20 times more pronounced for non-community banks. In terms of market power, we find a negative link with capitalisation. Banks with higher market power may be subject to regulatory forbearance in times of distress and thus hold less capital. Increased competition causes banks to hold higher capital levels, most likely as a buffer against the elevated probability of default that arises from operating in a more competitive environment. However, this effect is 22 times less pronounced for community banks. This result can be explained by the fact that issuing equity is more costly, especially for this bank group. Community banks have relatively greater difficulties to draw on capital markets. At times of higher competitiveness, it is more likely for community banks to turn to attracting more deposits rather than issuing more equity.

In summary, community banks hold higher capital levels than non-community banks and their capitalisation is less responsive to changes in their stability, cost efficiency and market power.

4.5.2 Results on Stability

The community bank dummy enters the equation with a positive coefficient suggesting higher stability for this bank group. Results from estimates of equation II suggest that there is a positive relationship between capital and stability, meaning that stability increases when capital increases. Holding more capital reduces the probability of bankruptcy as the bank is more capable of absorbing the losses incurred from non-performing loans and this enhances bank stability. This may relate to actions taken by the regulators, who would encourage banks to increase their capitalisation (reduce leverage) with the anticipated reaction being that the stability of these banks would increase. Also, managers of better capitalised banks have less moral hazard incentives to take on higher risk, resulting in higher stability for their banks; thus supporting the moral hazard hypothesis (Berger and DeYoung, 1997). Allowing for a difference in the business model does not change the direction of the relationship, but the magnitude of the response for community banks is around five times lower than that of the non-community ones. Furthermore, our results offer evidence of a "skimping behaviour" for both bank types as we find a negative relationship between efficiency and stability, indicating that more efficient banks bear higher risk. Bank managers, in their attempt to improve bank's cost efficiency in the short-run, reduce operating costs associated with loan due diligence. In the long-run though the deterioration of the quality of the loan portfolio becomes apparent.[47] The coefficient of the community bank interaction suggests that the direction of the effect is the same for this bank type, but the magnitude is two times smaller. In terms of competition we find clear evidence for the "competition-fragility" doctrine for both bank groups, with the effect being less pronounced for community banks as the lower coefficient on market power suggests (2.301-0.403=1.898). Under increased competition the bank is more tempted to pursue riskier policies and the likelihood of adverse selection increases resulting in deterioration of its overall soundness. In higher competition discounts in the quality of the borrowers is likely. For community banks the positive effect of greater market power on stability is less pronounced indicating that their loan due diligence process remains less vulnerable to competitive pressure.

Overall, the financial stability of community banks is less responsive to regulatory capitalisation changes and to cost skimping behaviour, whereas more competition is not as much a detriment for them as it is for their non-community counterparts.

4.5.3 Results on Efficiency

Results from estimates of equation III show that community banks are more efficient than their non-community counterparts. Higher capitalisation is associated with increased efficiency, however, community banks benefit around 20 times less from it. Banks that hold more capital adopt more risk reduction practices and appear to be more cost efficient. Community banks though might lack the managerial quality and sophisticated mechanisms to translate the additional equity capital into cost benefits. In terms of stability, riskier banks appear to be more efficient. Those banks are tempted to take on more risk to boost efficiency producing a positive relationship between risk and cost efficiency. The magnitude of this effect is 1.5 times smaller for community banks, suggesting that this bank type is less prone to this behaviour compared to non-community banks. Moreover, we document a positive link between efficiency and market power, i.e. negative link between efficiency and competition. Our results suggest that more competition among banks leads to inefficiency, thus rejecting the "quiet life" hypothesis of Berger and Hannan (1998). This result can be explained by a couple of reasons. Increased competition brings managers additional pressure to upgrade the quality of banking services

[47] It has been noted that banks may pursue higher cost efficiency strategies to enable them to take on more risk, see Altunbas et al. (2007).

provided. This increases operating costs and results in lower cost efficiency. In addition, more competition comes with a higher likelihood of adverse selection since it creates information dispersion among a larger number of banks and banks become less effective in their screening process. As the number of risky borrowers increases the monitoring costs increase as well. This result offers support for the information generating hypothesis of Marquez (2002). The magnitude of the effect though is very different between the two bank groups. For non-community banks competition is eight times more harmful for their efficiency than it is for community banks, suggesting that changes in their market power do not affect community banks' efficiency as much as they do for non-community.

In sum, community banks' efficiency benefits less from higher capitalisation and they are less prone to cost skimping behaviour to boost their efficiency. Competition does not affect their efficiency as unfavourably as it does with non-community banks.

4.5.4 Results on Market Power

The community bank dummy enters equation IV with a positive coefficient. Community banks hold proprietary information about their customers obtained through multiple interactions with them. This may give them information monopoly which translates into higher market power (Boot 2000). Clients prefer them on the basis of doing business with their local banker, perhaps instilling a sense of loyalty or help in times of need. Customers of community banks are willing to go the extra mile in order to do banking with a bank they trust. The relationship orientation of these banks makes them more unique relative to their competitors and this helps to alleviate competitive pressure. Stability and efficiency are positively related to market power. Institutions that maintain a sound loan portfolio, better asset quality and more sophisticated cost efficiency structures are more resilient to competitiveness in the market. The same holds for both community and non-community banks however the positive effect of efficiency on market power is much less for community banks. Furthermore, we notice a negative relationship between capitalisation and market power, (i.e. Lerner Index). A reduction in the Lerner Index can be explained by a reduction in the bank's relative mark-up of the market output price over the marginal cost. When this is falling the bank does not have the power to charge a lot more than what it costs to produce the service or it does not make abnormal profits. Additional equity lowers the bank's risk appetite so that it targets "safer loans" and that lowers per period profits for the bank. Also, the bank attracts funding from equity and liabilities. The defining characteristic of liabilities such as deposits and bonds, is that payments for them must be made by the bank and cannot be deferred. However, payments associated with equity are either in the form of a share price that is not immediately controlled by the bank or a dividend, which level can change. The bank can avoid paying both, so more equity does not put as pressure on the bank to perform relatively better in the market. The effect of capitalisation on market power for community banks is less pronounced, probably because they have fewer opportunities to diversify.

Overall, community banks have higher market power and are less competitive due to the uniqueness of the way they do banking. Capitalisation, stability and efficiency do not affect their market power as unfavourably as it does with non-community banks.

4.5.5 Impact of bank- specific, market structure and macroeconomic variables

In terms of bank- specific variables, we find a significant and positive relationship between liquidity creation and cost efficiency for both bank groups, with the effect being 1.5 times more pronounced for non-community banks. The more liquidity the bank creates the greater the likelihood of having to dispose illiquid assets to meet liquidity demands. The bank compensates for that by being more efficient in its operations. This is more intense for non-community banks as they are subject to greater market discipline and more regulatory scrutiny. Our results also suggest that liquidity creation is harmful for the institution’s market power. This sends a signal to the market that can harm the bank’s market power. Berger et al. (2010) indicate that regulators identify banks that create more liquidity and intervene to constrain it. Regulatory interventions and capital injections are associated with lower risk taking and liquidity creation. Both effects may be desirable since prominent bailed out institutions Northern Rock and UBS in the UK and Switzerland respectively were considered excessive liquidity creators. In this sense, our findings provide confirmatory evidence that regulators and bankers associations can identify high liquidity creators and intervene to constrain it. Size positively affects market power for both bank groups, however the magnitude is around 8.5 times more pronounced for non-community banks. Community banks do not reap as many advantages in terms of competitiveness by growing bigger as non-community banks do. Both liquidity and credit risk unfavourably affect stability for both bank groups.

A positive relationship between financial stress index and market power is evidenced for non-community banks, while the opposite holds for community banks. At times of financial turbulence there is more intense competition among community banks. This is plausible given the fact that community banks luck the sophisticated financial instruments and know-how to reverse unfavourable financial conditions, so they are adversely affected by higher financial stress in the market. Economic development as measured by real GDP growth affects positively non-community banks' market power and higher inflation adversely effects community banks' market power.

4.5.6 The channels of the traditional banking model

At this section we construct a traditional banking variable based on four characteristics that are associated with traditional banking practices.[48] First, relationship lending is one key characteristic of the traditional banking model and is proxied by the percentage of relationship loans to total assets. Relationship loans is the sum of business loans (i.e. commercial and industrial loans) and household loans (i.e. consumer loans and residential mortgages). A second distinctive feature of the traditional banking model is the use of relationship deposits to fund bank assets. The ratio of core deposits to total assets are used as a proxy for relationship deposits. Third, a bank that uses the traditional banking model will generate most of its income from traditional banking activities such as net interest margins, charges for services to depositors and fiduciary activities rather than non-interest income generating activities. Total traditional income includes the sum of traditional fee income (i.e. income from fiduciary activities and services charges on deposit accounts) and net interest income to total operating income. The fourth feature associated with traditional banking is the network of branches, measured as number of branches per $1000 of assets. Descriptive statistics for the variables associated with these activities are reported at Table 4.10 for the full sample and for community and non-community banks separately. The traditional banking variable (TBV) is equal to the percentage for which each bank exceeds the sample median of the four attributes calculated over a 3-year rolling window, takes values from 0 to 1 and measures the intensity at which the bank engages in traditional banking.

[Table 4.10 here]

[48] A similar approach has been used in Chiorazzo et al. (2018).

4.5.6.1 Benefits of traditional banking to non-community banks

Using the traditional banking variable described earlier, we test if and how the use of a more traditional banking approach, typically implemented by community banks, by the non-community banks affects key aspects of their operations along the lines of capitalization, stability, efficiency and market power. To do so, we re-estimate our main model (see section 4.3.1) only for the non-community banks, while including the traditional banking variable. The results of this estimation are presented in Table 4.11.

[Table 4.11 here]

Apart from the capitalisation equation, the coefficient of the traditional banking variable is significant and positive in all three other equations. This result indicates that there are *prima facie* advantages in terms of stability, efficiency and market power for non-community banks that are more oriented towards a traditional banking *modus operandi*. Especially when it comes to market power, the bank can reap significant benefits in terms of competitiveness if it follows this kind of traditional approach.

We take the analysis a step further to examine the specific channels through which the traditional banking approach bestows benefits upon the key aspects of non-community bank operations that the analysis presented in Table 4.11 identified. We augment the model estimated in Table 4.11 by allowing the interactions of the traditional banking variable (TBV) with each of the four channels that constitute the traditional banking model, namely relationship lending (RL/TA), deposit funding (Core deposits/TA), traditional income (TTI/TA), branch coverage (NB/TA). We estimate these models only for the non-community banks, and we allow for median sample splits based on total assets (Large/Small Banks) and the Traditional Banking Variable, which signifies non-community banks that are closer/further away from the traditional banking model (High/Low). For brevity we report only the coefficients and the robust standard errors of the interaction terms in Table 4.12.

[Table 4.12 around here]

For each of the four variables of interest we discuss the channels through which the benefits are bestowed in turn. In terms of capitalisation, high relationship lending (RL / TA) and deposit funding (Core deposits / TA) are linked with lower capitalization levels. The result is consistent across small and large banks as well as high and low traditional banking activity. By contrast, higher traditional income (TTI / TA) and more extensive branch network is related with higher capitalization. Overall, and as it can be inferred from Table 4.11, traditional banking practices do not significantly affect the capitalization levels of non-community banks.

In terms of stability, there is a significant and positive effect from traditional banking practices. An examination of the channels suggest that part of the benefit emerges from the increased use of relationship lending (RL / TA) and deposit funding (Core deposits / TA) practices. Asset-based splits suggest that the stability of large banks benefits more from higher relationship lending (RL / TA), while the stability of small banks is better enhanced through higher deposit funding (Core deposits / TA). Activity-splits show comparable gains for banking stability in both groups. Notable is the impact of traditional income (TTI / TA) on stability. Irrespective of bank size, gains in financial stability are anticipated through higher shares of traditional income (TTI / TA). However, catalytic is the importance of whether these banks are keen users of traditional banking approaches, with those populating the lower category (Low TBV) observing reductions in stability.[49]

Similar to stability, a significant positive effect of traditional banking practices on efficiency is also evidenced. Further examining of the channels shows that non-community banks with higher relationship lending practices (RL / TA) are linked with higher efficiency. The effect is more pronounced for small banks and keen users of traditional banking approaches (High TBV). In addition, small banks with higher shares of traditional income (TTI / TA) may be expected to be more efficient.

Traditional banking practices significantly enhance the market power of non-community banks. An examination of the channels through which this is manifested, suggests that a more extensive branch network (NB / TA) can increase the market power these banks command. This is plausibly linked to the close relationships they build and maintain with customers as well as the proximity benefits they enjoy around specific financial products (e.g., agricultural and small business loans). Furthermore, our results suggest that albeit high relationship lending practices (RL / TA) and increased shares of traditional income (TTI / TA) are associated with

[49] We observe that the impact of specific channels depends on the split (Large/Small bank size, High/Low TBV) and may occasionally not be at par with the combined effect represented in the All bank category. We attribute this to the confounding effects between bank size (Total Assets) and banking model (Traditional Banking Variable), whereby isolating a particular split may yield a certain effect but full sample may yield another.

stronger market power of non-community banks overall, these effects are likely susceptible to decreasing returns of scale as suggested by both the asset-based splits and the activity-splits.

4.5.6.2 Limitations of traditional banking to community banks

Using the traditional banking variable, we examine how such benefits manifest themselves upon community banks and whether there are points that maximise/minimize the gains to these banks from a traditional banking approach. We re-estimate the 3SLS model for the relationship between capital, stability, efficiency and market power for community banks only including the traditional banking variable and the quadratic term, and Table 4.13 presents the results.

We find evidence for a quadratic relationship between the traditional banking variable and all four variables of interest for community banks. The results of the coefficient estimates for all quadratic terms suggest that the relationship between traditional banking business model and capitalisation, stability, efficiency and market power is a U-shaped or inverse U-shaped rather than a linear one. Both stability and market power first increase and then decrease in proportion with the traditional banking orientation of the bank, suggesting that there exists an inversed U-shaped relationship between these two variables and traditional banking variable. The turning points beyond which stability and market power decrease is when the community bank operates at 65.5% and 67.04% of traditional banking business respectively. Given that the mean value for the traditional banking variable is 43% for community banks and the maximum is 57%, they experience the positive relationship between stability and market power and traditional banking. Meanwhile, the relationship of traditional banking variable with capital and efficiency is a U-shaped one. The community bank can minimize the capitalisation levels held when it operates at 65.81% of traditional banking variable and it reaches the minimum of efficiency levels when it operates at 67.24% of the traditional banking.

[Table 4.13 here]

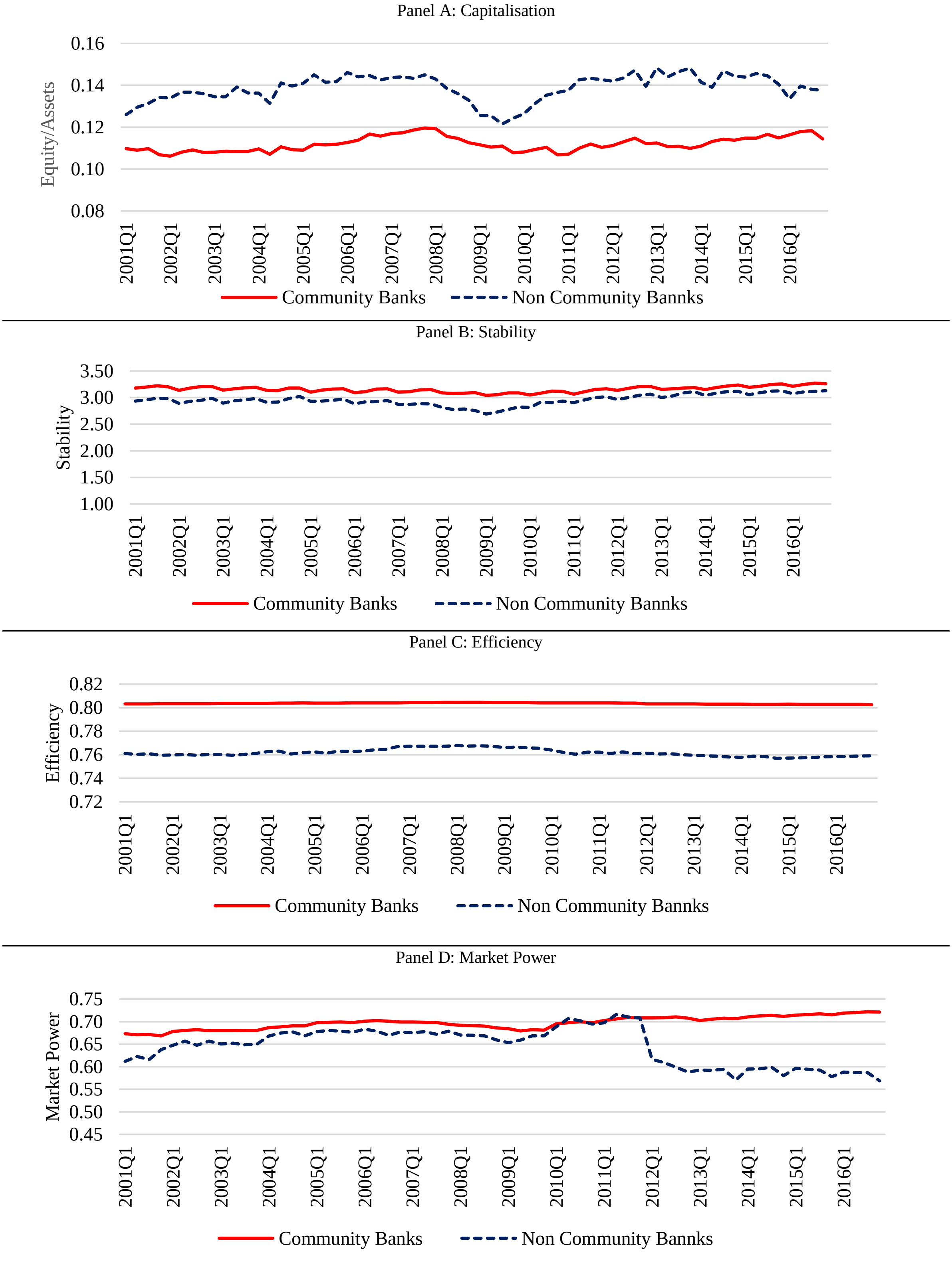
4.6 Conclusion

In this chapter we assess the relationships between capital, risk and efficiency for US banks over the period 2001 to 2015 and we build on previous work by including competition as a fourth factor in the analysis. We also distinguish between community and non-community banks, the former serving as a proxy for the traditional banking model. Our capitalization proxy is the equity over assets ratio, we use z-score as a proxy for insolvency risk, cost efficiency is estimated using the Kumbhakar et al. (2014) and Lerner index captures the degree of market power. Previous research in community banks has used a single criterion to define them, namely asset size. We innovate by using the FDIC (2012) definition that includes a range of financial and business type screening criteria and distinguishes community banks on the base of doing "relationship banking".

With regards to the community banks' business model, our empirical evidence suggests that this bank type exhibits higher capitalisation ratios, greater cost efficiency, superior financial stability and outperform non-community banks in terms of market power. A positive relationship between stability and capitalization is documented for both bank types supporting the "moral hazard hypothesis". More cost-efficient banks are shown to be better capitalized as they do not need to exhaust capital buffers to achieve higher earnings. We also find that there is evidence of cost skimping behaviours for both bank groups, however the community banks appear to be much less prone to this kind of practices. Our results offer support for the "competition-fragility" doctrine, with the effect being stronger for non-community banks and more muted for the community ones. We also find strong support for the "information generating hypothesis" especially for community banks, which reap the most benefits of information monopoly on their efficiency performance. Marker power is increased through higher efficiency for non-community banks and through higher liquidity creation for community banks. Finally, we report that even though a shift towards the traditional banking model can have positive impact on stability, efficiency and market power for non-community banks, it is not panacea and a rather quadratic relationship is documented.

Albeit the number of community banks in the US has been steeply declining for two decades, our results underline that adhering to the traditional banking business model can yield significant benefits both in terms of stability and efficiency. Furthermore, community banks have proven to be resilient in an environment of intense financial consolidation. Thus, we can draw the conclusion that this banking model offers the bank a unique advantage and can alleviate competitive pressures.

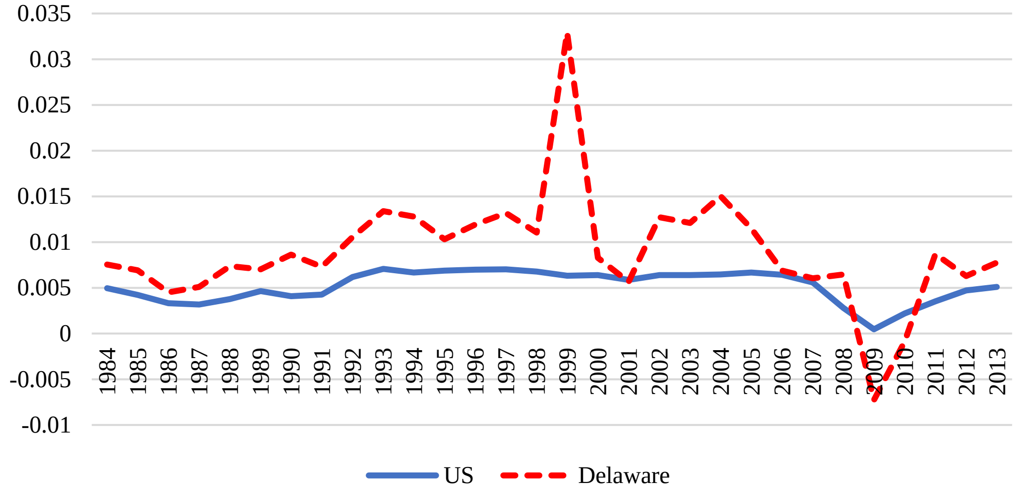
Figure 4.1: Capitalisation, stability, efficiency and market power across time for the two bank groups



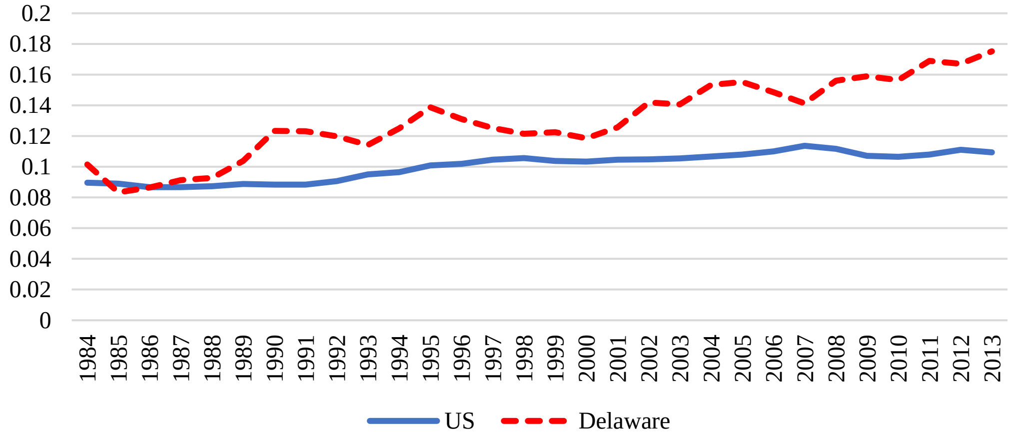
NOTES: Figure reports the mean values for capitalisation (Equity/Assets), stability (natural logarithm of z-score), efficiency (cost efficiency following (Kumbhakar et al. 2014) and market power (Lerner index) for community and non-community banks across time.

Figure 4.2: Earnings volatility for Delaware and US

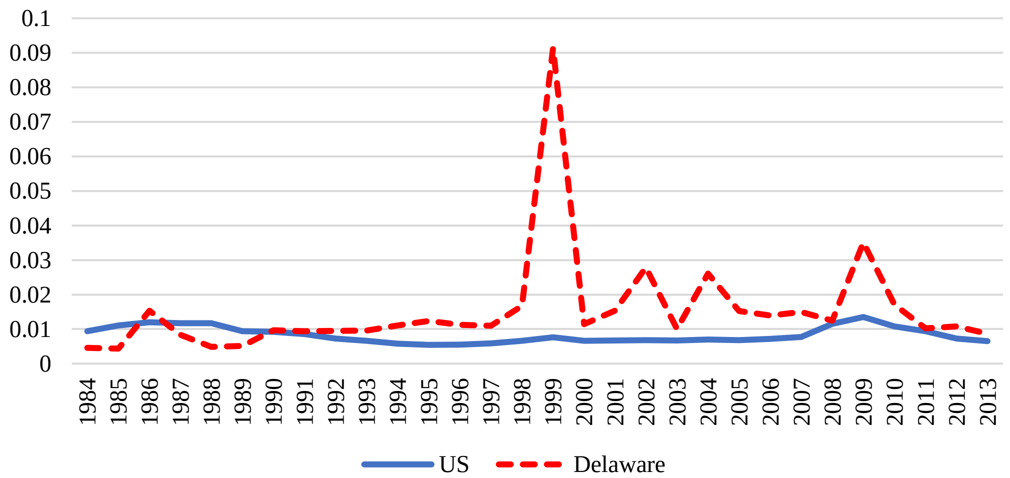
Panel A: ROA



Panel B: Equity/Assets



Panel C: SD (ROA)



NOTES: Figures report the mean values for the components of stability for Delaware and for all states across time.

Table 4.1: Summary statistics for capitalisation, stability, efficiency and market power

Variable	Obs	Mean	Median	SD	Min	Max
			Panel A: All Banks			
Capitalisation	464,561	0.115	0.101	0.065	0.052	0.821
Stability	464,448	3.137	3.243	0.635	0.864	4.517
Efficiency	464,725	0.801	0.800	0.035	0.545	0.886
Market Power	464,700	0.693	0.702	0.118	0.014	1.580
			Panel B: Community Banks			
Capitalisation	427,484	0.112	0.101	0.047	0.052	0.818
Stability	424,265	3.156	3.261	0.627	0.864	4.517
Efficiency	429,611	0.804	0.802	0.030	0.551	0.886
Market Power	429,930	0.696	0.706	0.098	0.014	1.579
			Panel C: Non-Community Banks			
Capitalisation	35,593	0.138^{***}	0.101	0.124^{***}	0.052	0.821
Stability	35,751	2.944^{***}	3.058^{***}	0.683^{***}	0.864	4.513
Efficiency	35,112	0.762^{***}	0.779^{***}	0.059^{***}	0.545	0.884
Market Power	34,768	0.652^{***}	0.640^{***}	0.257^{***}	0.014	1.580

NOTES: The table presents summary statistics for capitalisation, stability, efficiency and risk for all banks (Panel A), Community banks (Panel B) and Non-Community banks (Panel C). Capitalisation is proxied by the ratio of Equity to Assets, stability is proxied by the natural logarithm of the z-score, efficiency measures cost efficiency following Kumbhakar et al. (2014) and market power is proxied by the Lerner index. Variables are trimmed at 1 and 99%. *** denotes significance at 1% level.

Table 4.2: Summary statistics for capitalisation, stability, efficiency and market power by year

	Capitalisation				Stability				Efficiency				Market Power			
Year	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
2001	0.113	0.068	0.053	0.820	3.177	0.606	0.879	4.514	0.799	0.037	0.547	0.886	0.666	0.114	0.016	1.579
2002	0.112	0.066	0.052	0.821	3.159	0.607	0.865	4.515	0.800	0.037	0.547	0.886	0.678	0.118	0.016	1.579
2003	0.112	0.066	0.052	0.818	3.150	0.604	0.865	4.514	0.800	0.037	0.547	0.886	0.678	0.120	0.016	1.578
2004	0.113	0.067	0.052	0.820	3.136	0.608	0.877	4.514	0.800	0.036	0.547	0.886	0.688	0.117	0.020	1.579
2005	0.115	0.072	0.052	0.819	3.125	0.615	0.864	4.513	0.801	0.036	0.547	0.886	0.697	0.116	0.015	1.577
2006	0.119	0.080	0.053	0.820	3.112	0.623	0.870	4.516	0.801	0.036	0.547	0.886	0.699	0.113	0.018	1.579
2007	0.122	0.081	0.052	0.819	3.103	0.637	0.873	4.516	0.801	0.035	0.547	0.886	0.696	0.114	0.014	1.578
2008	0.119	0.075	0.052	0.821	3.057	0.666	0.864	4.516	0.801	0.035	0.547	0.886	0.688	0.123	0.015	1.579
2009	0.113	0.059	0.052	0.821	3.041	0.683	0.867	4.516	0.801	0.035	0.546	0.886	0.680	0.129	0.014	1.576
2010	0.112	0.056	0.052	0.819	3.076	0.669	0.866	4.517	0.801	0.035	0.547	0.886	0.698	0.126	0.015	1.580
2011	0.114	0.055	0.052	0.821	3.112	0.650	0.865	4.514	0.801	0.034	0.547	0.886	0.707	0.124	0.020	1.579
2012	0.116	0.055	0.052	0.821	3.168	0.665	0.864	4.516	0.801	0.034	0.545	0.886	0.703	0.110	0.016	1.542
2013	0.115	0.055	0.052	0.820	3.163	0.647	0.869	4.516	0.801	0.034	0.545	0.886	0.699	0.115	0.014	1.579
2014	0.116	0.052	0.052	0.821	3.189	0.632	0.867	4.516	0.800	0.034	0.545	0.886	0.706	0.112	0.014	1.553
2015	0.118	0.051	0.052	0.819	3.216	0.621	0.869	4.517	0.800	0.034	0.547	0.886	0.709	0.109	0.014	1.420

NOTES: Tables reports descriptive statistics for the four endogenous variables for the full sample by year, ranging from 2001 to 2015. Capitalisation is proxied by the ratio of Equity to Assets, stability is proxied by the z-score, efficiency measures cost efficiency following Kumbhakar et al. (2014) and market power is proxied by the Lerner index. Variables are trimmed at 1 and 99%.

Table 4.3: Summary statistics for capitalisation, stability, efficiency and market power by state

	Capitalisation				Stability				Efficiency				Market Power			
State	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
AK	0.117	0.045	0.064	0.241	3.470	0.228	2.860	4.500	0.772	0.025	0.657	0.789	0.602	0.060	0.317	0.713
AL	0.115	0.043	0.052	0.813	3.109	0.564	0.887	4.444	0.795	0.025	0.712	0.858	0.707	0.107	0.035	1.579
AR	0.113	0.036	0.053	0.520	3.236	0.503	0.997	4.440	0.794	0.029	0.654	0.876	0.690	0.090	0.015	0.891
AZ	0.128	0.075	0.052	0.806	2.385	0.669	0.871	4.439	0.796	0.039	0.580	0.878	0.627	0.154	0.016	1.545
CA	0.125	0.070	0.052	0.817	2.724	0.698	0.866	4.516	0.785	0.031	0.565	0.878	0.649	0.160	0.016	1.577
CO	0.100	0.035	0.052	0.675	2.861	0.628	0.870	4.450	0.789	0.042	0.626	0.877	0.683	0.112	0.021	1.575
CT	0.110	0.049	0.054	0.643	2.774	0.814	0.873	4.242	0.795	0.041	0.615	0.849	0.638	0.150	0.052	1.553
DE	0.156	0.108	0.053	0.725	2.604	0.715	0.867	4.503	0.750	0.077	0.561	0.847	0.651	0.261	0.014	1.554
FL	0.114	0.062	0.052	0.810	2.624	0.734	0.865	4.507	0.791	0.029	0.645	0.881	0.645	0.127	0.016	1.579
GA	0.108	0.048	0.052	0.772	2.690	0.695	0.866	4.509	0.800	0.023	0.631	0.869	0.669	0.098	0.026	1.578
HI	0.108	0.049	0.057	0.449	2.517	0.713	1.185	3.949	0.791	0.009	0.781	0.808	0.761	0.384	0.054	1.579
IA	0.109	0.031	0.052	0.355	3.326	0.396	0.870	4.516	0.811	0.024	0.717	0.865	0.734	0.075	0.016	0.930
ID	0.124	0.067	0.055	0.724	2.839	0.653	0.883	4.505	0.793	0.027	0.733	0.858	0.627	0.091	0.232	1.469
IL	0.105	0.031	0.052	0.812	3.151	0.650	0.864	4.516	0.801	0.030	0.584	0.877	0.698	0.106	0.016	1.579
IN	0.108	0.032	0.055	0.497	3.385	0.515	0.921	4.503	0.796	0.032	0.556	0.859	0.669	0.102	0.057	1.577
KS	0.110	0.035	0.052	0.635	3.254	0.507	0.872	4.471	0.814	0.028	0.705	0.880	0.724	0.091	0.022	0.900
KY	0.112	0.033	0.052	0.621	3.285	0.519	0.874	4.483	0.806	0.023	0.683	0.871	0.685	0.088	0.024	1.568
LA	0.108	0.031	0.053	0.743	3.270	0.462	0.933	4.502	0.794	0.028	0.705	0.865	0.697	0.099	0.023	1.578
MA	0.102	0.082	0.053	0.817	3.244	0.633	1.040	4.449	0.788	0.023	0.723	0.841	0.632	0.166	0.014	1.559
MD	0.104	0.038	0.053	0.736	3.003	0.645	0.876	4.516	0.791	0.015	0.732	0.841	0.638	0.113	0.018	1.573
ME	0.095	0.029	0.053	0.379	3.251	0.580	0.880	4.160	0.797	0.014	0.775	0.826	0.616	0.108	0.042	1.458
MI	0.105	0.034	0.053	0.627	3.053	0.665	0.865	4.487	0.799	0.023	0.612	0.868	0.659	0.111	0.020	1.566
MN	0.105	0.032	0.052	0.586	3.035	0.529	0.867	4.488	0.816	0.027	0.603	0.883	0.727	0.078	0.017	1.381
MO	0.105	0.030	0.052	0.610	3.175	0.520	0.872	4.509	0.807	0.027	0.696	0.885	0.702	0.090	0.021	0.906
MS	0.106	0.024	0.053	0.537	3.268	0.476	0.897	4.420	0.790	0.037	0.551	0.865	0.671	0.107	0.024	1.562
MT	0.107	0.028	0.062	0.411	3.087	0.540	1.071	4.482	0.813	0.027	0.667	0.862	0.730	0.081	0.108	0.881
NC	0.114	0.064	0.052	0.788	2.846	0.722	0.879	4.484	0.790	0.025	0.617	0.852	0.624	0.138	0.017	1.578

ND	0.100	0.023	0.055	0.223	3.174	0.380	1.007	4.414	0.815	0.027	0.719	0.876	0.736	0.108	0.014	0.901
NE	0.112	0.038	0.054	0.428	3.290	0.477	0.874	4.488	0.820	0.027	0.705	0.879	0.740	0.078	0.030	0.923
NH	0.114	0.081	0.061	0.814	3.333	0.577	1.502	4.332	0.781	0.049	0.575	0.835	0.665	0.120	0.019	1.405
NJ	0.107	0.054	0.052	0.755	2.926	0.730	0.902	4.509	0.784	0.034	0.594	0.857	0.619	0.122	0.015	1.569
NM	0.100	0.022	0.053	0.334	2.989	0.520	0.914	4.124	0.786	0.043	0.586	0.846	0.697	0.098	0.045	1.575
NV	0.123	0.068	0.054	0.754	2.278	0.679	0.871	4.105	0.788	0.040	0.549	0.878	0.669	0.135	0.046	1.497
NY	0.108	0.043	0.053	0.807	3.201	0.637	0.899	4.378	0.782	0.044	0.564	0.884	0.674	0.183	0.023	1.580
OH	0.109	0.043	0.052	0.796	3.389	0.497	0.868	4.514	0.803	0.030	0.645	0.861	0.699	0.113	0.020	1.575
OK	0.107	0.033	0.052	0.437	3.109	0.463	0.869	4.477	0.805	0.029	0.668	0.868	0.717	0.100	0.015	1.558
OR	0.120	0.058	0.053	0.781	2.691	0.698	0.899	4.513	0.797	0.029	0.667	0.862	0.645	0.116	0.023	1.572
PA	0.106	0.043	0.052	0.732	3.228	0.582	0.869	4.510	0.788	0.024	0.646	0.862	0.633	0.120	0.015	1.579
RI	0.102	0.039	0.053	0.336	3.142	0.559	1.535	4.300	0.796	0.036	0.706	0.834	0.597	0.211	0.045	1.248
SC	0.110	0.047	0.052	0.755	2.937	0.697	0.873	4.495	0.795	0.024	0.729	0.858	0.648	0.115	0.023	1.574
SD	0.117	0.036	0.052	0.430	3.208	0.497	0.955	4.497	0.810	0.035	0.628	0.863	0.725	0.110	0.023	1.459
TN	0.110	0.043	0.052	0.758	3.070	0.616	0.885	4.513	0.797	0.028	0.567	0.881	0.671	0.096	0.021	1.529
TX	0.109	0.037	0.052	0.759	3.152	0.524	0.868	4.516	0.791	0.037	0.595	0.885	0.702	0.103	0.015	1.578
UT	0.126	0.049	0.053	0.668	2.623	0.668	0.874	4.195	0.785	0.047	0.557	0.866	0.728	0.154	0.029	1.575
VA	0.108	0.041	0.052	0.699	3.115	0.610	0.869	4.456	0.790	0.026	0.586	0.863	0.639	0.110	0.014	1.540
VT	0.094	0.017	0.070	0.165	3.503	0.255	2.645	4.292	0.795	0.038	0.649	0.861	0.633	0.116	0.398	1.578
WA	0.110	0.049	0.052	0.803	2.681	0.765	0.864	4.467	0.795	0.027	0.671	0.866	0.647	0.117	0.018	1.426
WI	0.111	0.035	0.052	0.771	3.254	0.530	0.900	4.511	0.804	0.031	0.546	0.869	0.705	0.084	0.029	1.578
WV	0.107	0.025	0.054	0.373	3.434	0.470	1.295	4.506	0.802	0.025	0.593	0.863	0.692	0.079	0.041	0.829
WY	0.099	0.024	0.054	0.315	2.980	0.488	0.941	4.381	0.796	0.038	0.651	0.865	0.717	0.085	0.018	0.886

NOTES: Table reports summary statistics for the four endogenous variables of our analysis for the full sample per state. Capitalisation is proxied by the ratio of Equity to Assets, stability is proxied by the z-score, efficiency measures cost efficiency following Kumbhakar et al. (2014) and market power is proxied by the Lerner index. Variables are trimmed at 1 and 99%.

Table 4.4: Ranking of the states based on the endogenous variables

State	Capitalisation	Stability	Efficiency	Market Power
AK	8	2	49	49
AL	10	27	26	12
AR	14	16	29	21
AZ	2	49	23	44
CA	4	41	44	33
CO	45	37	39	23
CT	18	40	28	39
DE	1	47	50	32
FL	13	45	32	37
GA	28	43	15	28
HI	29	48	35	1
IA	23	7	6	4
ID	5	39	31	45
IL	39	23	14	17
IN	30	5	21	29
KS	21	12	4	9
KY	15	9	9	22
LA	26	10	30	19
MA	43	15	41	43
MD	42	32	33	40
ME	49	14	17	48
MI	38	30	16	31
MN	40	31	2	7
MO	41	20	8	15
MS	36	11	37	25
MT	32	28	5	5
NC	11	38	36	46
ND	46	21	3	3
NE	16	8	1	2
NH	12	6	48	30
NJ	33	36	46	47
NM	47	33	43	18
NV	6	50	42	27
NY	27	19	47	24
OH	24	4	12	16
OK	35	26	10	10
OR	7	42	19	36
PA	37	17	40	42
RI	44	24	20	50
SC	20	35	24	34
SD	9	18	7	8
TN	22	29	18	26
TX	25	22	34	14
UT	3	46	45	6
VA	31	25	38	38
VT	50	1	27	41
WA	19	44	25	35
WI	17	13	11	13
WV	34	3	13	20
WY	48	34	22	11

NOTES: Table reports ranking order of the states based on each one of the four endogenous variables.

Table 4.5: Mean values for the components of stability and efficiency for Delaware and US

	All states	Delaware
Price of labour	23.783	33.005
Price of capital	0.278	0.434
Price of funds	0.030	1.386
Loans/Total Assets	0.581	0.667
Securities/Total Assets	0.271	0.151
ROA	0.005	0.009
Equity/Assets	0.098	0.129
SD(ROA)	0.009	0.022

NOTES: Table reports mean values for efficiency and stability components for Delaware and for all states across the full time span of our analysis.

Table 4.6: Comparison of DE with ND, ID and NH

	Population (2018)	Total GDP (2018)	Number of institutions (2018)	Percentage of community banks (2018)	Stability (1984-2013)	Efficiency (1984-2013)
North Dakota (ND)	758,080	59,286.8 million	75	100%	3.174	0.815
Idaho (ID)	1.751 million	79,090.8 million	13	100%	2.839	0.793
New Hampshire (NH)	1.353 million	84,584.1 million	18	100%	3.333	0.781
Delaware (DE)	965,479	74,186.7 million	22	Less than 39%	2.604	0.750

NOTES: Table reports population size, total GDP, number of FDIC banking institutions, share of community banks, stability and efficiency scores for the states of North Dakota (ND), Idaho (ID), New Hampshire (NH) and Delaware (DE).

Table 4.7: Percentage change in the mean value of the endogenous variables between the beginning of our sample period and the end per state

	Capitalisation			Stability			Efficiency			Market Power		
State	2001	2015	diff	2001	2015	diff	2001	2015	diff	2001	2015	diff
AK	0.137	0.115	-16.425%	3.503	3.458	-1.273%	0.757	0.777	2.748%	0.560	0.576	2.943%
AL	0.109	0.123	12.626%	3.137	3.211	2.381%	0.794	0.795	0.109%	0.681	0.719	5.510%
AR	0.106	0.120	12.831%	3.210	3.265	1.696%	0.793	0.797	0.416%	0.650	0.715	9.991%
AZ	0.109	0.114	4.898%	2.610	2.171	-16.820%	0.780	0.801	2.653%	0.612	0.632	3.159%
CA	0.103	0.121	18.113%	2.958	2.678	-9.473%	0.778	0.788	1.321%	0.605	0.671	11.033%
CO	0.093	0.108	16.507%	2.949	2.872	-2.620%	0.785	0.800	1.974%	0.668	0.695	4.048%
CT	0.104	0.104	0.431%	3.162	2.749	-13.058%	0.782	0.788	0.864%	0.634	0.651	2.787%
DE	0.132	0.115	-13.044%	2.776	2.158	-22.258%	0.745	0.742	-0.485%	0.584	0.621	6.276%
FL	0.109	0.110	1.317%	2.827	2.662	-5.847%	0.788	0.792	0.523%	0.628	0.665	5.798%
GA	0.102	0.112	10.373%	2.877	2.785	-3.185%	0.797	0.802	0.559%	0.650	0.699	7.604%
HI	0.079	0.109	37.022%	2.622	2.444	-6.805%	0.787	0.792	0.687%	0.726	0.601	-17.213%
IA	0.106	0.115	8.525%	3.312	3.388	2.290%	0.811	0.810	-0.192%	0.696	0.762	9.554%
ID	0.095	0.125	31.925%	2.888	2.805	-2.884%	0.790	0.796	0.794%	0.610	0.642	5.283%
IL	0.101	0.112	10.647%	3.146	3.286	4.451%	0.799	0.801	0.313%	0.665	0.720	8.329%
IN	0.104	0.110	5.633%	3.398	3.475	2.266%	0.794	0.797	0.352%	0.642	0.693	8.011%
KS	0.108	0.114	5.718%	3.248	3.311	1.952%	0.812	0.815	0.363%	0.692	0.747	8.023%
KY	0.104	0.122	17.261%	3.260	3.344	2.566%	0.806	0.806	0.010%	0.659	0.699	5.999%
LA	0.111	0.113	1.539%	3.325	3.319	-0.180%	0.795	0.794	-0.124%	0.670	0.715	6.786%
MA	0.112	0.107	-4.548%	3.353	3.215	-4.127%	0.789	0.788	-0.079%	0.627	0.619	-1.213%
MD	0.111	0.105	-5.133%	3.177	2.995	-5.706%	0.789	0.793	0.532%	0.626	0.653	4.312%
ME	0.086	0.102	18.270%	3.218	3.598	11.795%	0.797	0.791	-0.754%	0.577	0.656	13.817%
MI	0.102	0.109	6.539%	3.081	3.137	1.825%	0.796	0.801	0.539%	0.634	0.668	5.327%
MN	0.101	0.110	8.814%	3.035	3.108	2.422%	0.814	0.816	0.249%	0.699	0.755	7.944%
MO	0.100	0.109	9.290%	3.177	3.242	2.038%	0.808	0.807	-0.137%	0.676	0.721	6.669%
MS	0.106	0.112	5.059%	3.281	3.352	2.141%	0.792	0.788	-0.448%	0.643	0.682	6.126%
MT	0.104	0.111	7.461%	3.193	3.061	-4.149%	0.810	0.814	0.422%	0.696	0.745	6.970%
NC	0.123	0.108	-12.418%	3.173	2.827	-10.927%	0.783	0.790	0.899%	0.612	0.617	0.751%
ND	0.106	0.101	-5.024%	3.256	3.189	-2.034%	0.813	0.817	0.490%	0.700	0.762	8.834%
NE	0.112	0.113	0.908%	3.289	3.345	1.697%	0.819	0.820	0.221%	0.710	0.763	7.575%
NH	0.087	0.177	104.426%	3.345	3.190	-4.646%	0.769	0.786	2.192%	0.680	0.685	0.718%
NJ	0.118	0.100	-15.420%	3.217	2.796	-13.070%	0.776	0.788	1.615%	0.588	0.641	9.107%

NM	0.099	0.103	4.138%	2.978	3.060	2.749%	0.781	0.786	0.591%	0.662	0.716	8.210%
NV	0.119	0.122	2.176%	2.500	2.301	-7.976%	0.767	0.803	4.652%	0.619	0.730	17.901%
NY	0.104	0.111	6.935%	3.352	3.144	-6.202%	0.780	0.783	0.343%	0.665	0.657	-1.212%
OH	0.103	0.114	11.126%	3.362	3.474	3.328%	0.799	0.805	0.760%	0.670	0.716	6.821%
OK	0.106	0.110	3.237%	3.135	3.135	-0.002%	0.806	0.805	-0.115%	0.681	0.738	8.341%
OR	0.106	0.114	7.969%	2.980	2.641	-11.375%	0.797	0.803	0.821%	0.644	0.655	1.704%
PA	0.107	0.109	2.154%	3.328	3.265	-1.915%	0.785	0.789	0.404%	0.607	0.648	6.660%
RI	0.079	0.131	65.335%	3.217	3.429	6.615%	0.766	0.808	5.387%	0.573	0.593	3.396%
SC	0.112	0.108	-2.962%	3.139	2.955	-5.848%	0.799	0.791	-1.026%	0.652	0.651	-0.103%
SD	0.115	0.117	2.186%	3.168	3.261	2.925%	0.808	0.812	0.447%	0.683	0.755	10.547%
TN	0.106	0.110	3.233%	3.178	3.114	-2.008%	0.795	0.799	0.502%	0.645	0.694	7.605%
TX	0.103	0.109	5.498%	3.189	3.169	-0.630%	0.790	0.790	0.005%	0.674	0.722	7.086%
UT	0.118	0.127	7.746%	2.656	2.739	3.119%	0.784	0.778	-0.691%	0.706	0.732	3.675%
VA	0.101	0.112	11.283%	3.267	3.101	-5.059%	0.782	0.794	1.433%	0.613	0.654	6.726%
VT	0.096	0.095	-0.867%	3.422	3.501	2.327%	0.790	0.801	1.383%	0.611	0.626	2.437%
WA	0.101	0.110	8.945%	2.754	2.885	4.765%	0.792	0.794	0.191%	0.625	0.660	5.597%
WI	0.104	0.121	16.234%	3.239	3.331	2.837%	0.804	0.804	0.023%	0.667	0.728	9.154%
WV	0.108	0.110	1.896%	3.416	3.471	1.610%	0.800	0.802	0.231%	0.660	0.701	6.162%
WY	0.096			2.989	3.023	1.136%	0.789	0.798	1.048%	0.695	0.735	5.722%

NOTES: Table reports mean values for the four endogenous variables per state and percentage change in the mean values between the beginning of our sample period (2001) and the end (2015) per state.

Table 4.8: Summary statistics for the explanatory variables

Variable	Obs	Mean	Median	SD	Min	Max
Panel A: All Banks						
Total Assets	479,414	11.894	11.773	1.363	4.190	21.092
ROA	479,414	0.005	0.005	0.103	-50.841	21.720
Liquidity Risk	469,824	0.169	0.170	0.225	-0.567	0.868
Credit Risk	456,147	0.159	0.031	0.368	-0.178	3.479
HHI Loans	517,453	0.562	0.497	0.225	0.146	1.000
Liquidity Creation	413,784	0.316	0.319	0.652	-0.912	230.036
Panel B: Community Banks						
Total Assets	432,838	11.753	11.702	1.102	7.313	17.480
ROA	432,838	0.005	0.005	0.014	-1.392	2.309
Liquidity Risk	430,304	0.175	0.176	0.221	-0.567	0.868
Credit Risk	423,079	0.152	0.029	0.355	-0.178	3.479
HHI Loans	432,684	0.574	0.506	0.224	0.163	1.000
Liquidity Creation	379,600	0.301	0.311	0.179	-0.882	3.477
Panel C: Non-Community Banks						
Total Assets	41,695	13.638***	13.564***	2.125***	4.190	21.092
ROA	41,695	0.006***	0.006***	0.344***	-50.841	21.720
Liquidity Risk	36,893	0.125***	0.111***	0.249***	-0.566	0.867
Credit Risk	32,877	0.256***	0.065***	0.496***	-0.177	3.478
HHI Loans	39,955	0.553***	0.478***	0.255***	0.146	1.000
Liquidity Creation	34,184	0.476***	0.424***	2.181***	-0.912	230.036

NOTES: The table presents summary statistics for the explanatory variables used in the 3SLS model for all banks (Panel A), Community banks (Panel B) and Non-Community banks (Panel C). Total Assets are estimated with logs. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Liquidity and credit risk are trimmed at 1% and at 99%. *** denotes statistical significance at 1% level.

Table 4.9: Three stage least square estimation for the relationship between Capital, Stability, Efficiency and Market power

Variables	Capital	Stability	Efficiency	Market Power
	I	II	III	IV
Capital		48.43***	0.327***	-3.185***
		(0.348)	(0.0100)	(0.0846)
Stability	0.173***		-0.00721***	0.0721***
	(0.00121)		(0.000618)	(0.00466)
Efficiency	0.842***	-7.105***		24.03***
	(0.0201)	(0.375)		(0.255)
Market Power	-0.618***	2.301***	0.317***	
	(0.0113)	(0.154)	(0.00364)	
Community Bank	0.265***	2.059***	0.626***	17.60***
	(0.0231)	(0.375)	(0.00581)	(0.223)
Capital × CB		-38.99***	-0.310***	2.647***
		(0.349)	(0.0100)	(0.0846)
Stability × CB	-0.137***		0.00252***	0.00415
	(0.00121)		(0.000615)	(0.00464)
Efficiency × CB	-0.800***	3.407***		-20.95***
	(0.0203)	(0.377)		(0.253)
Market Power × CB	0.590***	-0.403***	-0.276***	
	(0.0113)	(0.154)	(0.00365)	
Total Assets	-0.0363***	0.0724***	0.00887***	0.214***
	(0.000729)	(0.0105)	(0.000255)	(0.00307)
Total Assets × CB	0.0300***	-0.0186*	-0.0312***	-0.189***
	(0.000727)	(0.0106)	(0.000259)	(0.00302)
Liquidity Risk		-0.426***		
		(0.0240)		
Liquidity Risk × CB		0.323***		
		(0.0245)		
Credit Risk		-0.0761***		
		(0.00995)		
Credit Risk× CB		-0.0275***		
		(0.0104)		
ROA	0.240***			
	(0.0515)			
ROA× CB	-0.128**			
	(0.0522)			
Liquidity Creation			0.0722***	-1.778***
			(0.000786)	(0.0204)
Liquidity Creation× CB			-0.0289***	1.602***
			(0.000817)	(0.0204)
HHI Loans			0.0122***	
			(0.000635)	
HHI Loans× CB			-0.0181***	
			(0.000642)	
Real GDP Growth		-1.911**	-0.303***	7.173***
		(0.791)	(0.0229)	(0.224)
Real GDP Growth× CB		1.704**	0.342***	-7.809***
		(0.796)	(0.0231)	(0.228)
CPI		-1.910**	0.0821***	0.634***
		(0.815)	(0.0234)	(0.182)
CPI× CB		1.648**	-0.0850***	-0.812***
		(0.828)	(0.0238)	(0.183)
Fedfunds		0.0453***	0.000939***	

		(0.00393)	(0.000110)	
Fedfunds× CB		-0.0528***	-0.00126***	
		(0.00279)	(7.79e-05)	
CEAI	-0.00744			
	(0.0313)			
CEAI× CB	-0.0271			
	(0.0314)			
Unemployment				-0.0512***
				(0.00131)
Unemployment× CB				0.0525***
				(0.00104)
10Y2Y				0.0170***
				(0.00179)
10Y2Y× CB				-0.0180***
				(0.00157)
Financial Stress Index				0.0500***
				(0.00154)
Financial Stress Index× CB				-0.0549***
				(0.00147)
Constant	-0.214***	1.222***	0.411***	-19.81***
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	343,244	343,244	343,244	343,244
Chi^2	118767.16***	164454.40***	594680.72***	151257.02***

NOTES: Capital, risk, efficiency and competition proxies are trimmed at 1% and 99%. We are using one lag for the bank- specific variables and four lags for the macro variables. We are using log of total assets. CPI and CEAI is calculated as the difference in logs. 10Y2Y is the 10 minus 2 years treasury bond. Financial stress index measures the degree of financial stress in the markets. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). The credit and liquidity risk proxies are calculated following Imbierowicz and Rauch (2014). Standard errors clustered at the bank level are reported in brackets. ***, **, *

Table 4.10: Summary statistics for the traditional banking variable and its components

Variable	Obs	Mean	Median	SD	Min	Max
Panel A: All banks						
Total Loans (% of Assets)	479,414	0.607	0.640	0.186	-0.021	0.997
Business Loans (% of Assets)	479,350	0.023	0.000	0.056	0.000	2.301
Household Loans (% of Assets)	479,350	0.209	0.183	0.145	0.000	1.545
Relationship Loans (% of Assets)	479,350	0.232	0.208	0.153	0.000	3.846
Real Estate Loans (% of Assets)	479,350	0.108	0.025	0.143	0.000	0.959
Core Deposits (% of Assets)	476,284	0.796	0.829	0.171	-59.39	1.152
Traditional Fee Income (per $1000 of Assets)	479,414	8.548	1.475	101.9	-0.148	34,351
Total Traditional Income (per $1000 of Assets)	479,414	30.51	23.10	103.4	-1,140	34,719
Total Traditional Income (% of Total Operating Income)	481,074	0.683	0.692	0.612	-365.0	36.166
Total Non-Interest Income (per $1000 of Assets)	479,414	13.42	3.243	117.8	-1,026	34,351
Number of Branches (per $1000 of Assets)	474,493	0.349	0.026	14.52	0.001	2,092
Traditional Banking Variable	471,564	0.430	0.432	0.054	0.243	0.573
Panel B: Community Banks						
Total Loans (% of Assets)	432,838	0.622	0.643	0.158	0.000	0.987
Business Loans (% of Assets)	432,774	0.019	0.000	0.048	0.000	0.861
Household Loans (% of Assets)	432,774	0.212	0.186	0.140	0.000	0.944
Relationship Loans (% of Assets)	432,774	0.231	0.207	0.146	0.000	0.944
Real Estate Loans (% of Assets)	432,774	0.110	0.034	0.142	0.000	0.960
Core Deposits (% of Assets)	433,139	0.813	0.836	0.093	0.000	1.067
Traditional Fee Income (per $1000 of Assets)	432,838	2.202	1.451	6.013	-0.148	768.3
Total Traditional Income (per $1000 of Assets)	432,838	24.25	22.94	13.67	-11.72	786.9
Total Traditional Income (% of Total Operating Income)	433,102	0.687	0.694	0.251	-96.00	36.17
Total Non-Interest Income (per $1000 of Assets)	432,838	4.808	3.094	24.99	-352.4	4,805
Number of Branches (per $1000 of Assets)	432,815	0.045	0.027	0.095	0.000	10.70
Traditional Banking Variable	428,879	0.432	0.433	0.052	0.243	0.573
Panel C: Non-Community Banks						
Total Loans (% of Assets)	41,695	0.526	0.635	0.300	-0.021	0.995
Business Loans (% of Assets)	41,695	0.072	0.041	0.102	0.000	2.301

Household Loans (% of Assets)	41,695	0.207	0.172	0.188	0.000	1.545
Relationship Loans (% of Assets)	41,695	0.279	0.264	0.202	0.000	3.847
Real Estate Loans (% of Assets)	41,695	0.109	0.000	0.159	0.000	0.867
Core Deposits (% of Assets)	43,145	0.635	0.705	0.455	-59.39	1.152
Traditional Fee Income (per $1000 of Assets)	41,695	16.32	1.549	205.7	-0.017	34,351
Total Traditional Income (per $1000 of Assets)	41,695	39.02	22.92	213.6	-1,140	34,719
Total Traditional Income (% of Total Operating Income)	43,098	0.623	0.655	1.881	-365.0	9.097
Total Non-Interest Income (per $1000 of Assets)	41,695	38.16	5.209	253.5	-1,026	34,351
Number of Branches (per $1000 of Assets)	41,678	3.512	0.050	48.88	0.000	2,092
Traditional Banking Variable	38,157	0.406	0.410	0.065	0.243	0.573

Notes: Table reports descriptive statistics for the variables associated with the traditional banking model as per Chiorazzo et al. (2018) and for the traditional banking variable for all banks (panel A), community banks (panel B) and non-community banks (panel C) .

Table 4.11: The benefits of the traditional banking model on non-community banks.

Variables	**Capital**	**Stability**	**Efficiency**	**Market Power**
	I	**II**	**III**	**IV**
Capital	—	12.38*	-0.002	-0.433
		(6.733)	(0.071)	(1.778)
Stability	0.021***	—	-0.015***	-0.380***
	(0.005)		(0.003)	(0.072)
Efficiency	0.127***	-3.909***	—	-26.71***
	(0.033)	(0.507)		(0.680)
Market Power	-0.190***	1.304***	-0.037***	—
	(0.022)	(0.367)	(0.001)	
Traditional Banking Variable	-0.007	1.111**	0.087***	2.286***
	(0.012)	(0.465)	(0.007)	(0.179)
Total Assets	-0.014***	0.086***	-0.015***	-0.408***
	(0.002)	(0.020)	(0.001)	(0.011)
Liquidity Risk	—	-0.002	—	—
		(0.127)		
Credit Risk	—	-0.093***	—	—
		(0.010)		
ROA	0.608***	—	—	—
	(0.084)			
Liquidity Creation	—	—	0.060***	1.612***
			(0.002)	(0.060)
HHI	—	—	0.001	—
			(0.001)	
Real GDP Growth	—	-1.096	0.024	0.689
		(0.872)	(0.048)	(1.202)
CPI	—	-0.470	0.019	0.553
		(0.852)	(0.041)	(1.026)
Fedfunds	—	-0.001	0.005*	—
		(0.010)	(0.001)	
CEAI	0.006	—	—	—
	(0.040)			
Unemployment	—	—	—	-0.001
				(0.001)
T10Y2Y	—	—	—	-0.001
				(0.001)
Financial Stress Index	—	—	—	0.001
				(0.001)
Constant	0.212***	2.742***	0.983***	26.30***
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	19,993	19,993	19,993	19,993
Chi^2	3,583***	5,918***	16,779***	2,524***

Notes: Only Non-community banks are included here. Capital, risk, efficiency and competition proxies and the traditional banking variable are trimmed at 1% and 99%. We are using one lag for the bank- specific variables and four lags for the macro variables. We are using log of total assets. CPI and CEAI is calculated as the difference in logs. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). The credit and liquidity risk proxies are calculated following Imbierowicz and Rauch (2014). Standard errors clustered at the bank level are reported in brackets. ***, **, *denote statistical significance at the 1, 5 and 10% respectively.

Table 4.12: Channels of traditional banking model benefits.

		Relationship lending	Deposit funding	Traditional income	Branch coverage
Capital	**All Banks**	**-0.0914***** **(0.0099)**	**-0.1420***** **(0.0100)**	**0.1260**** **(0.0525)**	**14.350***** **(4.1360)**
	Large Banks	-0.1050*** (0.0137)	-0.1400*** (0.0130)	0.0930* (0.0545)	22.750*** (4.7950)
	Small Banks	-0.0837* (0.0481)	-0.1710*** (0.0616)	-0.2610 (0.1950)	40.660** (20.220)
	High TBV	-0.1150*** (0.0161)	-0.0901*** (0.0145)	0.1580*** (0.0560)	-21.580*** (6.8780)
	Low TBV	-0.1320*** (0.0163)	-0.2050*** (0.0150)	0.0823 (0.0848)	18.80*** (5.949)
Stability	**All Banks**	**2.5640***** **(0.5880)**	**2.7560***** **(0.7530)**	**-7.5700***** **(2.6960)**	**51.570** **(141.70)**
	Large Banks	1.4050* (0.7210)	1.0410 (0.8580)	7.6680** (3.7450)	646.60* (341.40)
	Small Banks	0.6660 (0.6970)	2.1890* (1.2170)	5.0210* (2.5940)	-616.40 (733.60)
	High TBV	2.0180*** (0.2480)	2.4530*** (0.7440)	-1.570 (1.420)	257.40 (299.50)
	Low TBV	2.0050*** (0.6680)	3.2240*** (1.1600)	-3.0760* (1.6650)	-82.690 (126.60)
Efficiency	**All Banks**	**0.0441***** **(0.0077)**	**-0.0592*** **(0.0355)**	**0.0619** **(0.0443)**	**-14.880***** **(3.5420)**
	Large Banks	0.0620*** (0.0086)	-0.0281 (0.0274)	0.0443 (0.0481)	-14.440*** (4.2920)
	Small Banks	0.0980** (0.0395)	0.0562 (0.0621)	0.4080*** (0.1380)	-217.10* (120.40)
	High TBV	0.1620*** (0.0114)	-0.1040*** (0.0191)	0.0298 (0.0577)	5.5160 (7.1600)
	Low TBV	-0.00366 (0.0305)	-0.117 (0.0721)	0.0486 (0.0721)	-7.670 (6.026)
Market Power	**All Banks**	**0.2510**** **(0.1060)**	**-1.6900***** **(0.1730)**	**1.2260**** **(0.5440)**	**120.70**** **(51.810)**
	Large Banks	-0.9420*** (0.1270)	-0.2350 (0.5210)	-0.9100 (1.0650)	191.30*** (63.650)
	Small Banks	-0.6810* (0.3790)	-0.7810* (0.4230)	-2.4900** (1.1270)	253.20*** (89.530)
	High TBV	-0.9790*** (0.1990)	2.0110*** (0.5030)	-0.9000 (1.7200)	-24.500 (57.620)
	Low TBV	-0.7640*** (0.1200)	-1.9550*** (0.2970)	0.5560 (0.5220)	180.10*** (55.610)

Notes: The table presents the estimates of the model described in section 3.1 with the addition of a traditional banking variable (TBV) and the interactions of TBV with each of the four channels that characterise the traditional banking model, namely relationship lending, deposit funding, traditional income and branch coverage (see section 5.6 for full description). For brevity we present only coefficients and standard errors in parenthesis of these interaction terms. The model is estimated for the non-community bank as per the description in section 3.1. The full sample estimation is referred as "All banks", Large/Small banks and High/Low TBV are split on the basis of Total Assets, and traditional banking variable respectively. *, **, *** denote statistical significance at the 10, 5 and 1% significance levels respectively.

Table 4.13: The limitations of the traditional banking model on community banks.

Variables	**Capital**	**Stability**	**Efficiency**	**Market Power**
	I	**II**	**III**	**IV**
Capital	—	63.53***	-1.311***	10.53***
		(1.268)	(0.023)	(0.182)
Stability	0.015***	—	0.017***	-0.151***
	(0.001)		(0.001)	(0.006)
Efficiency	-0.746***	45.97***	—	7.588***
	(0.014)	(1.394)		(0.149)
Market Power	0.093***	-5.764***	0.129***	—
	(0.004)	(0.165)	(0.003)	
Traditional Banking Variable	-0.283***	18.50***	-0.347***	2.903***
	(0.014)	(0.627)	(0.017)	(0.137)
Traditional Banking Variable Squared	0.215***	-14.11***	0.258***	-2.165***
	(0.016)	(0.716)	(0.019)	(0.151)
Total Assets	-0.017***	1.075***	-0.023***	0.175***
	(0.001)	(0.032)	(0.001)	(0.004)
Liquidity Risk	—	0.014***	—	—
		(0.004)		
Credit Risk	—	-0.026***	—	—
		(0.003)		
ROA	0.007	—	—	—
	(0.013)			
Liquidity Creation	—	—	-0.001*	0.015***
			(0.001)	(0.005)
HHI	—	—	-0.003***	—
			(0.001)	
Real GDP Growth	—	-0.238	0.004	0.002
		(0.161)	(0.003)	(0.021)
CPI	—	-0.943***	0.011***	-0.039
		(0.164)	(0.003)	(0.026)
Fedfunds	—	0.004**	-0.001	—
		(0.002)	(0.001)	
CEAI	0.007***	—	—	—
	(0.001)			
Unemployment	—	—	—	0.004*
				(0.002)
T10Y2Y	—	—	—	-0.003***
				(0.001)
Financial Stress Index	—	—	—	0.006***
				(0.001)
Constant	0.806***	-52.24***	1.181***	-8.705***
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	321,657	321,657	321,657	321,657
Chi^2	62,717	16,793	141,674	24,200

Notes: Only community banks are included here. Capital, risk, efficiency and competition proxies and the traditional banking variable are trimmed at 1% and 99%. We are using one lag for the bank- specific variables and four lags for the macro variables. We are using log of total assets. CPI and CEAI is calculated as the difference in logs. CatFat is the preferred measure for liquidity creation, following Berger and Bowman (2009). CatFat is normalized by GTA. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). The credit and liquidity risk proxies are calculated following Imbierowicz and Rauch (2014). Standard errors clustered at the bank level are reported in brackets. ***, **, *denote statistical significance at the 1, 5 and 10% respectively.

Appendix 4.1

Cost efficiency estimation – The Kumbhakar et al. (2014) model

We start with a standard cost function that in a panel data specification may be specified as:

$$\ln c_{it} = \alpha_0^* + f\,(y_{it}w_{it};\, \beta) + \alpha_i + \varepsilon_{it} \tag{1}$$

where $i = 1, \ldots, N$ denotes the bank and $t = 1, \ldots, T_i$ denotes the time period during which bank i is observed, c_{it} are the total costs, y_{it} the vector of outputs, w_{it} the vector of input prices, $f(\cdot)$ the cost function, α_i is the random effect for bank i and ε_{it} is the stochastic error term for bank i at time t. In addition, the following quantities are defined: the constant is $\alpha_0^* = \alpha_0 - E(\eta_i) - E(u_{it})$; the $\alpha_i = \mu - \eta_i + E(\eta_i)$; and the $\varepsilon_{it} = \nu_{it} - u_{it} + E(u_{it})$. This ensures that α_i and ε_{it} have zero mean and constant variance.

The Kumbhakar et al. (2014) model splits the error term into four components, taking this way into account different factors affecting the output given the inputs. The first component is firm's latent heterogeneity which is disentangled from the inefficiency effects, the second captures time-varying inefficiency, the third is time invariant inefficiency and the last component captures random shocks. The model may be rewritten as:

$$\ln c_{it} = \alpha_0 + f\,(y_{it}w_{it};\, \beta) + \mu_i + \nu_{it} - \eta_i - u_{it} \tag{2}$$

This model has four components, $\eta_i > 0$ and $u_{it} > 0$ are inefficiency and μ_i and ν_{it} are bank random effects and noise respectively.

To estimate the model in (2) we follow the three-step procedure outlined in Kumbhakar et al. (2015). Equation (2) could be rewritten as equation (1). In the first step a standard panel random effects regression is used to estimate $\hat{\beta}$ from equation (1) and the predicted values of α_i and ε_{it} which are $\hat{\alpha}_i$ and $\hat{\varepsilon}_{it}$. In the second step estimates of time-varying cost efficiency (u_{it}) are obtained via a standard SFA on ε_{it} of step 1. Specifically, we estimate the equation outlined below as a standard SFA assuming ν_{it} is i.i.d. N(0,σ_ν^2) and u_{it} is N^+(0,σ_u^2)

$$\varepsilon_{it} = \nu_{it} - u_{it} + E(u_{it}) \tag{3}$$

This step gives prediction of the time-varying residual cost inefficiency components $\hat{u}_{it}$. In step 3 estimates of the persistent cost efficiency η_i are obtained via a standard SFA on α_i of step 1. Specifically, the following equation is estimated as a standard SFA assuming μ_i is i.i.d. N(0,σ_μ^2) and η_i is i.i.d. $N^+(0,\sigma_\eta^2)$.

$$\alpha_i = \mu_{it} - \eta_i + E(\eta_i) \tag{4}$$

Finally, the overall cost efficiency is calculated as the product of persistent and residual cost efficiency, namely: $OCE = PCE \times RCE$. Persistent efficiency may be attributed to factors that remain relatively constant on a short time period, such as regulatory changes, structural rigidities, and business/management practices. These are factors that need to be accounted for when long time periods are concerned. Residual efficiency captures the time-varying efficiency that is specific at the bank level. For the cost function we adopt the following translog cost specification:

$$\begin{aligned}\ln\left(\frac{TC}{p3}\right) = \beta_0 &+ \sum\nolimits_m (\theta_m lny_m) + \sum\nolimits_n \left(\beta_n ln\frac{p_n}{p_3}\right) \\ &+ \frac{1}{2}\sum\nolimits_m \sum\nolimits_j (\theta_{mj} lny_m lny_j) \\ &+ \frac{1}{2}\sum\nolimits_n \sum\nolimits_k (\beta_{nk} ln\frac{p_n}{p_3} ln\frac{p_k}{p_3}) \\ &+ \sum\nolimits_n \sum\nolimits_m (\gamma_{nm} ln\frac{p_n}{p_3} lny_m) + \mu_i + v_{it} - \eta_i - u_{it}\end{aligned} \tag{5}$$

We follow the existing literature in the choice of input and output variables assuming that bank act as intermediaries between fund surplus and deficit units (Beccalli et al. 2006; Berger et al. 2011; Kaparakis et al. 1994). The input variables are the *price of labour (p1)* defined as the salaries and employee benefits over the number of full-time equivalent employees, the *price of capital (p2)* defined as expenses on premises and fixed assets over premises and fixed assets and the *price of funds (p3)* defined as total interest expenses over total deposits. We define *total cost* as the sum of total interest expense and total non-interest expense. All monetary variables have been deflated using the GDP deflator.

Appendix 4.2

Estimating marginal cost using a translog cost function

Following Beck et al. (2013) we derive the marginal cost estimation using SFA and 1 output case.

More specifically we estimate:

$$\ln\ C_{it} = a_0 + a_1 lnQ_{it} + 0.5 \times a_2 lnQ_{it} \times lnQ_{it} + \sum_{j=1}^{3} \beta_j lnw_{it}^{j} + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} lnw_{it}^{j} \times lnw_{it}^{k} + \sum_{j=1}^{3} \gamma_j lnw_{it}^{j} \times lnQ_{it} + v_t + \varepsilon_{it} \quad (1)$$

Where C_{it} is total operating costs and Q_{it} is a proxy for bank output (total loans) for bank *i* at time *t*. The three input prices capture the price of capital w^1, the price of labor w^2 and the price of funds w^3. They are constructed as expenses of premises and fixed assets and other non- interest expense to total assets, salaries and employee benefits to total assets and interest expenses to total. Marginal cost is obtained via the first difference of the translog function with respect to the output and becomes as follows:

$$MC_{i,t} = \frac{\partial C_{i,t}}{\partial Qi,t} = \frac{C_{i,t}}{Q_{i,t}} \left(\hat{a}_1 + 2\hat{a}_2 lnQ_{i,t} + \sum_{j=1}^{2} \hat{\gamma}_j ln \frac{w_{i,t}^{j}}{w_{i,t}^{3}} \right) \quad (2)$$

Appendix 4.4

Liquidity risk and Credit risk proxy variables

Category	Proxy	Calculation	Values
Liquidity Risk	Imbierowicz and Rauch (2014) measure (LR)	$LR_t = [(\text{Demand Deposits}_t + \text{Transaction Deposits}_t + \text{Brokered Deposits}_t + \text{NOW Accounts}_t + \text{Unused Loan Commitments}_t) - (\text{Cash}_t + \text{Currency \& Coin}_t + \text{Trading Assets}_t + \text{Fed Funds Purchased}_t + \text{Commercial Paper}_t + \text{Securities available for Sale}_t) \pm \text{Net Interbank Lending Position}_t \pm \text{Net Interbank Acceptances}_t \pm \text{Net Derivative Position}_t] \frac{1}{Total\ Assets_t}$	Values above zero imply that the bank is ceteris paribus not able to endure a sudden bank run
Credit Risk	Imbierowicz and Rauch (2014) measure (CR)	$CR_t = \frac{Loan\ charge-offs_t - Loan\ Recoveries_t}{Loan\ Loss\ Allowance_t}$	Values above 1 indicate unexpected losses

NOTES: The table displays descriptions and calculations of the proxy variables for liquidity and credit risk. The liquidity risk proxy is standardised by total assets and indicates to what degree the bank is able to cover sudden and unexpected liquidity demand with liquid assets. The credit risk proxy is calculated by dividing the net loan charge-offs by the loan loss allowance in the previous year. It indicates the degree to which the current period losses were expected in the period before.

Chapter 5 – Conclusion

Community banks conduct business in ways that are different from those of non-community banks, however their long-standing presence in the US banking system suggests that they compete effectively with their non-community counterparts. This thesis conducts a thorough comparative analysis between the two bank types and seeks to identify sources of advantage for community banks. First of all, we compare the financial risk profile of community and non-community banks in terms of insolvency, credit and liquidity risk and question whether their risk profile shows similar or different sensitivities to key bank-specific, macroeconomic and market structure characteristics. Results suggest that the sensitivity to financial risk shows variations among the two bank groups. Community banks are more financially stable and derive significant advantages in terms of stability from having higher capitalization, better asset quality and higher liquidity whereas, a larger asset base does not seem to produce additional benefit for this particular bank group. Community banks outperform non-community in terms of credit risk and their source of advantage comes from their capitalization and income diversification strategies. However, we find that non-community banks outperform community when it comes to liquidity risk. Community banks' focus on traditional loan making activities and limited access to capital markets causes these banks to bear higher liquidity risk.

Secondly, we examine the efficiency dynamics of community banks. To do so, we rely on the Kumbhakar et al (2014) model which allows the decomposition of cost efficiency into a residual and a persistent component that captures managerial weaknesses and market structure/regulatory rigidities respectively. We document that community banks exhibit higher cost efficiency than non-community banks. The largest part of the cost efficiency gap between the two bank groups comes from differences in persistent efficiency that are linked to bank-specific developments in the sector. We also compare the determinants of cost efficiency of community and non-community banks across a wide array of explanatory variables. We report a negative link between bank size and cost efficiency, with the magnitude being stronger for community banks suggesting that these banks perform better when they are small in size. Community banks that are part of a bank holding company exhibit lower cost efficiency scores, possibly due to differences in objectives and goals that exist between community and non-community banks. We also find that higher liquidity creation translates into lower cost efficiency for community banks but higher for non-community.

Thirdly, we assess the relationship between capital, risk, efficiency and competition for US banks, distinguishing between community and non-community banks. Our empirical analysis here validates our results from the previous chapters on higher stability and greater cost efficiency for community banks. We also document higher capitalization and market power for this particular bank group. A positive relationship between stability and capitalization is documented for both bank types supporting the "moral hazard hypothesis". We document evidence of cost skimping behaviour for both bank types, however community banks are found to be significantly less prone to this practice. We find support for the "competition-fragility" doctrine with the effect being more pronounced for community banks and for the "information generating hypothesis" where again community banks appear to reap the most benefits from information monopoly. Finally, we document quadratic relationship between the traditional banking model and stability, efficiency and market power for non-community banks suggesting that these banks can reap certain benefits from engaging in that type of banking model however it is not panacea.

The current thesis contributes to the banking-related literature in a number of ways. First, this is the first study that defines community banks on the basis of business model and geographical criteria rather than relying on a single, size criterion that previous research on this topic has used. Second, it contributes to the literature on the comparative performance of relationship banks versus commercial banks and identifies any benefits that arise from engaging into this type of approach in terms of financial risk, efficiency and market power. Third, we conduct a joint investigation of insolvency, credit and liquidity risk which, to the best of our knowledge, has not been conducted before in the community banking research. Forth, we innovate methodologically by applying a novel model of cost efficiency in the context of community banking. This model is particularly relevant for this bank type, since it identifies whether Fed's softer regulatory touch on community banks has managed to actually translate into benefits in their persistent efficiency. Fifth, this is the first time that the effect of liquidity creation on cost efficiency is being investigated. Furthermore, we introduce an important forth factor in the capital-efficiency-stability nexus that has been precluded in existing literature i.e. competition. Finally, we quantify the benefits and limitations of the traditional banking model for non-community and community banks.

Our research offers a number of new insights into the economic performance of relationship lenders. These findings can be generalized to other institutional environments outside the US where this type of banking approach exists. In Germany for example, the notion of "house-bank" is closely related to the relationship banking approach. House-bank relationships describe the ties between large or medium-sized firms and their main bank, which often is a savings or a cooperative bank rather than a large bank (Behr and Schmidt 2015). The House-bank is the main credit provider for the firm. Repeated personal interactions from lending relationships are also evident in Italy, where tighter bank-firm relationships helped Italian businesses to alleviate the effects of GFC by maintaining higher levels of investment and employment (Banerjee et al. 2017). But besides the US and EU, relationship lending plays a key role in developing countries. In these economies it is critical for microfinance services to reach the financially excluded population segments. The main mechanism through which entrepreneurs and small businesses can access credit is relationship banking. In India, firms tend to create close ties with state-owned banks and to interact with a smaller number of banks (Berger et al. 2008). Similarly, domestic banks in Pakistan have a comparative advantage when it comes to soft information-based relationship loans and thus they are more successful at renegotiating with the borrowers and enjoy lower default rates (Mian 2006).

Albeit the number of community banks in the US has been steeply declining for two decades, our results underline that adhering to the traditional banking business model can yield significant benefits in terms of stability, efficiency and market power. Thus, we can draw the conclusion that this banking model offers the bank a unique advantage and can alleviate competitive pressures. This creates additional challenges for community banks who need to compete in the same environment with non-community banks. Therefore, the implication of any bank policy should take into consideration the distinct risk profile of the two bank types. Measuring the effect of bank regulation remains a critical issue that poses substantial challenges for the supervisors.

Regulatory burden is perhaps the greatest challenge that community banks face (CSBS, 2018). Compliance costs are especially burdensome for small institutions and are the root of concerns for community bankers. Regulators attempt to ease the regulatory burden and their current proposals revolve around the deregulation of these banks. For instance, the U.S Department of the Treasury (2017) suggested regulation to be tailored according to bank size and the Economic Growth, Regulatory Relief and Consumer Protection Act (2017) recommended to adapt regulation based on size criteria for small banks. The analysis conducted in this thesis has shown that community banks are a remarkably dynamic part of the banking industry. This is something that the regulators have acknowledged and hence aim to provide a softer regulatory touch to keep community banks in the game. The community banks' superior persistent efficiency that has been documented in chapter three suggests that advantageous policy changes rather than short-term management adaptations are able to enhance efficiency for this bank group, thus putting the spotlight on the need for further regulatory relief. Results from chapter two indicate that capitalisation translates into insolvency and credit risk-reduction benefits. Applying regulatory thresholds for community banks capital levels yields into stability and portfolio quality gains. Furthermore, higher liquidity creation is associated with lower cost efficiency (chapter 3). However, pursuing a strategy that maximizes liquidity creation may be desirable by the regulators because it channels funds into the real economy and this is a core function of community banks. Policies aimed to increase cost efficiency in these institutions may come at the expense of less liquidity created for their communities as these too variables are found to be inversely related. Finally, findings from all chapters act in a reassuring way for maintaining the relationship-lending model and thus regulatory actions should enhance it.

5.1 Limitations and Future Research

One of the concerns of community bankers that consistently ranks high up in their agendas is about compliance costs (CSBS, 2019). Compliance costs expressed as a share of non-interest expense have been on a rising trend since 2014, reaching $4.9 billion in 2018 on average, while they are expected to rise even further (CBRO, 2018). On the one hand the compliance cost burden falls heavier on the smaller of community banks, which need to dedicate funds to cope with the increased requirements of specific regulations (e.g., Bank Secrecy Act, Community Reinvestment Act), financial reporting conditions (e.g., Call reports, Basel III requirements), and the introduction of new loan monitoring methodologies (e.g., the current expected credit loss model - CECL) as well as the transition away from deeply-rooted practices like the linking of variable-rate loans to LIBOR that is superseded by the Secured Overnight Financing Rate (SOFR).

On the other hand, the regulator is pushing for deregulation across the board on smaller banks in order to level the playing field with the larger institutions. As such and in accordance with the Economic Growth, Regulatory Relief and Consumer Protection Act (EGRRCPA), community banks may benefit from simplified Call report fillings, extended and off-site examination cycle, reduced requirements related to the Home Mortgage Disclosure Act

(HMDA), relief from Dodd-Frank Act stress test requirements and an exemption from the Volker rule among others (CSBS, 2019). While taken independently these measures may be greeted with scepticism on their effectiveness, taken collectively may significantly reduce the regulatory burden and allow community bankers to focus on banking business. Srivastav and Vallascas (2019) provide evidence that favourable regulation for small banks facilitates their role in providing credit for small businesses.

In our studies we have accounted for personnel costs that represent over 80% of a community bank's non-interest expenses (CSBS, 2018). We have opted not to include compliance costs, namely i) data processing, ii) accounting and auditing, iii) consulting and advising, and iv) legal costs due to data availability issues. Whilst acknowledging this limitation, we plausibly attribute the higher persistent efficiency (see chapter 3) of community banks to the softer regulatory touch these banks enjoy, and leave this as a direction for future research.

At the time of writing of this thesis the COVID 19 pandemic continues to unfold with over 27 million cases confirmed in more than 200 countries. The current pandemic has created an unprecedented systemic shock to the global economy, comparable in magnitude to the GFC and even the Great Depression.[50] Following the GFC banks halted their key liquidity transformation function (i.e., credit crunch), which lead to the economic recession that followed. However, small banks were able to extend their financing to borrowers for two main reasons. First, the relationship lending business model, typically practiced by these banks. In times of crises soft information can play a catalytic role in complementing hard information when assessing lending decisions. For example, Gartner (2011) and Hardie and Howarth (2013) indicate the business model of regional banks in Germany as the main reason behind their robust performance following the GFC. Second, the fact that community banks tend to raise funding through retained earnings and deposits; thus being capable of acting countercyclically – in contrast to capital market funding (Hardie and Howarth 2013). Community banks demonstrated their ability to weather the GFC (see chapter 2). Still, questions are raised on whether they will be able to do so again now, especially during a time when competitive pressure from fintech companies has increased sharply. Many companies, especially SMEs are likely to need further financing or credit deferrals from their banks to weather the effects of the economic shutdown caused by the pandemic. In the US, the CAREs

[50] See Figure 1 in Baker et al., (2020) here: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3569410

Act (Coronavirus Aid, Relief, and Economic Security Act) established new temporary programs to help SMEs overcome the adverse effect of COVID 19 outbreak such as the SBA Express Bridge Loans and the SBA Debt Relief. These loans are guaranteed by the Small Business Administration federal agency. Community banks carry a lot of these SBA loans which rocketed during the pandemic. So, the onus is on the community banks to perform their liquidity creation function and support the backbone of the economy[51]. However, this brings up questions regarding the solvency of such loans. If too many loans default community banks can be at risk of financial difficulties. Besides solvency, moral hazard issues can be at stake as these emergency reliefs are backed up by the state and the SBA has waived many of the usual requirements for these loans[52]. Future research can test the effectiveness of the implemented Act in the COVID 19 environment. Furthermore, it can explore the channels through which community banks can cushion the economic impacts of COVID 19 and compare the behaviour of different types of financial providers.

[51] https://www.worldbank.org/en/topic/smefinance
[52] https://www.bloomberg.com/news/articles/2014-04-15/a-senator-sees-moral-hazard-in-sba-loan-program

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